Spatial Configuration in Communication via a MRP System

Annica Kristoffersson, Center of Applied Autonomous Sensor Systems (AASS), Örebro University, Sweden.
E-mail: annica.kristoffersson@oru.se

Giraff is a mobile robotic telepresence (MRP) system with an elderly target audience. It consists of a mobile base on which a nonadjustable pole is attached. Mounted on the pole is a 14.1" tiltable standing screen equipped with a wide-angle lens web cam, a microphone, and speakers. As Giraff is intended to be used in homes of elderly, it has a heavy base enabling it to clear thresholds and obstacles with minimal risk of tipping. The Giraff is driven from a PC software with either a mouse or a touchpad.

An issue raised in evaluations with elderly and representatives of different organizations within the scope of ExCITE has been the importance of privacy. Therefore, motivated by the intended use in homes, a database is used to handle who has access to a Giraff. In normal usage, the local user has to respond to the "calls", however also an emergency call access level exists.

Spatial formations: Adam Kendon observed what spatial formations arise when two or more people sustain a spatial and orientational relationship. He found there were three formations (F-formations [1]): vis-a-vis, L-shape and Side-by-side. The shared space created by the F-formation .is called the *O-space* and is the overlap of the spaces where the people direct their attention [1,2].

In this work we were interested in how the quality of interaction with others was perceived and how it differed depending on spatial formations. In this figure: 1, 4 and 5 are F-formations:

0. Look-away, 1. Vis-a-vis, 2. Ahead, 3. Follow, 4. L-shape and 5. Side-by-side. The dotted ovals denote the O-space. The elder is black and the Giraff is grey.
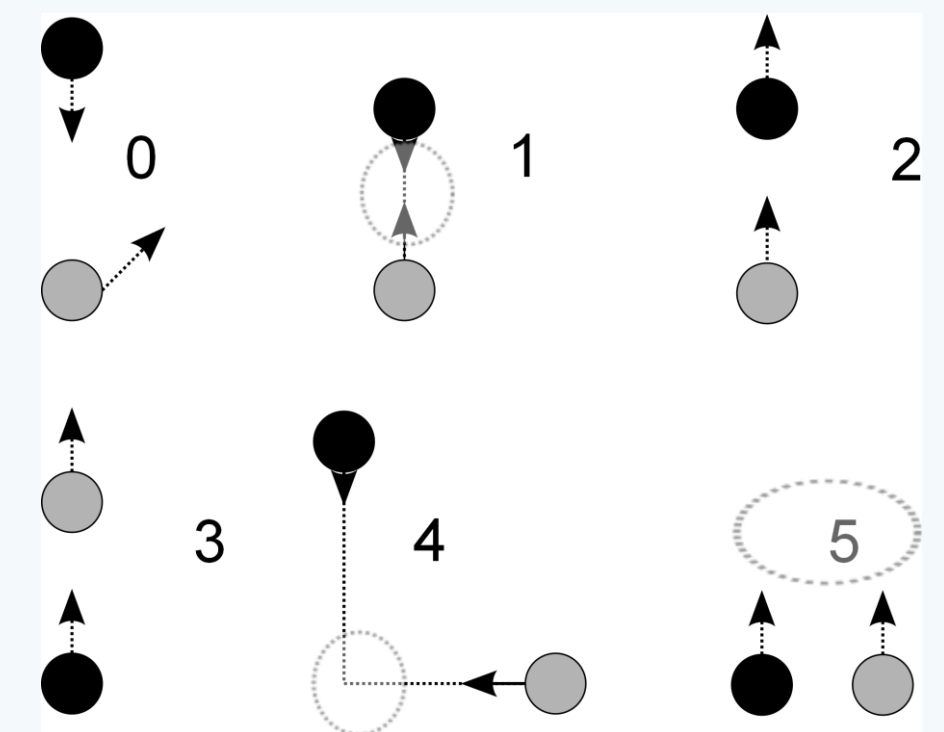
Experiments on F-formations in human-robot interaction (HRI) imply that the theory is applicable [3-5]. However, whether the F-formations occur when using a MRP system and whether the choice of spatial formation impacts how the interaction are open research questions. Therefor, we have performed two experiments with Giraff; one from the pilot point of view and one from the elderly point of view.

Experiment 1 (This material is extracted from [6].)

21 novice users working as alarm operators, responding to alarms coming from elderly were invited to a training session where they tried driving Giraff for the first time. The users did a scripted visit in a "home" via Giraff. As such they were asked to behave as if it was a real visit. All training sessions were filmed for later analysis of spatial formations. Specifically we were interested in analyzing the spatial formation in four situations:

- **S1 –** Whether the pilot followed the elder to the kitchen.
- **S2 –** Whether the pilot formed a vis-a-vis while talking about a delicate matter in the kitchen
- **S3 –** Whether the pilot went ahead of the elder when asked to find the remote to the television set
- **S4 –** Whether the pilot would form a L-shape when describing the location of the remote which was located in a space restricted area where forming a Side-by-side was difficult.

In S1, 18 out of 21 (86%) *followed* the elder. The other three (14%) drove ahead of the elder. While interacting in the kitchen (S2), only 14/21 (67%) formed a *vis-a-vis* with the elder. The other 7 (33%) did not turn Giraff towards the elder but instead looked away. In S3, 13/21 /62%) drove ahead of the elder when asked to find the remote , but 8 followed the elder. In S4, only 13/21 formed the expected L-shape when finding the remote and 8 unexpectedly formed a side-by-side.

One-way anova tests show that *the choice of spatial formation influenced the participants' perceived presence*. The ones who drove ahead of the elder in S1 experienced the interaction with the elder with a higher attentional engagement [7] than the ones following the elder. The ones forming the expected L-shape in S4 experienced a higher comprehension [7] than the ones choosing the side-by-side.

The choice of formation also correlated with the perceived ease of use of the system. The ones doing the expected *vis-a-vis* in S2 thought it was both easier to leave the docking station and to make a u-turn than the ones doing the unexpected look-away in the kitchen. The researcher also observed that the ones forming the side-by-side in S4 steered the Giraff with more difficulty. It could be the case that the ones perceiving Giraff as easier to use had to put less of an effort in forming the spatial formations.

References:
[1] A. Kendon, "Conducting interaction: patterns of behavior in focused encounters," *Cambridge University Press*, 1990.
[2] P. Marshall, Y. Rogers and N. Pantidi, "Using F-formations to analyse spatial patterns on interaction in physical environments," *In Proceedings of CSCW 2011*, pp. 454-454, 2011.
[3] H Kuzuoka, Y. Suzuki, J. Yamashita and K. Yamazaki, "Reconfiguring spatial formation arrangement by robot body orientation," *In Proceedings of HRI*, pp. 285-294, 2010.
[4] F. Yamaoka, T. Kanda , H. Ishiguro and N. Hagita, "A model of proximity control for information-pesenting robots," *IEEE Trans Robots*, vol. 26, no. 1, pp. 187-194, 2010.
[5] H. Hüttenrauch, E. Topp and K. Severinson Eklundh, "The art of gate-crashing bringing HRI into users' homes," *Interact Stud*, vol. 10, no. 3, pp. 275-298, 2009.
[6] A. Kristoffersson, K. Severinson Eklundh and A. Loutfi, "Measuring the Quality of Interaction in Mobile Robotic Telepresence A Pilot's Perspective..*International Journal of Social Robotics,* 2012. DOI: 10.1007/s12369-012-0166-7.
[7] F. Biocca and C. Harms, "Guide to the networked minds social presence inventory," http://cogprints.org/6743.

Experiment 2 (Initial analysis)

To follow up on the results of Experiment 1, 10 elderly were invited for a guiding tour in a showcase apartment. The guide was embodied in Giraff. The scenario required sitting and standing for the elderly and the pilot either performed primarily a *vis-a-vis* or the *look-away* formation that had been observed among the novice users in Experiment 1. The tours with the elderly were filmed to allow for retrospective interviews as well as an analysis of the spatial formations. **It was of interest to see whether such behavior via the Giraff was perceived as comfortable among elderly.**

Evident in the interviews was the importance of *eye contact*:
- **Ex 1** "[...] it should be turned towards me. The contact is needed."
- **Ex 2** "The eye contact was there, I think that part is important."
- **Ex 3** "I almost had to move myself so that I could see her.[...] I should see the one I talk to."

The importance also clearly showed in analysis of video data where participants who experienced the look-away formation moved themselves towards a *vis-a-vis*.
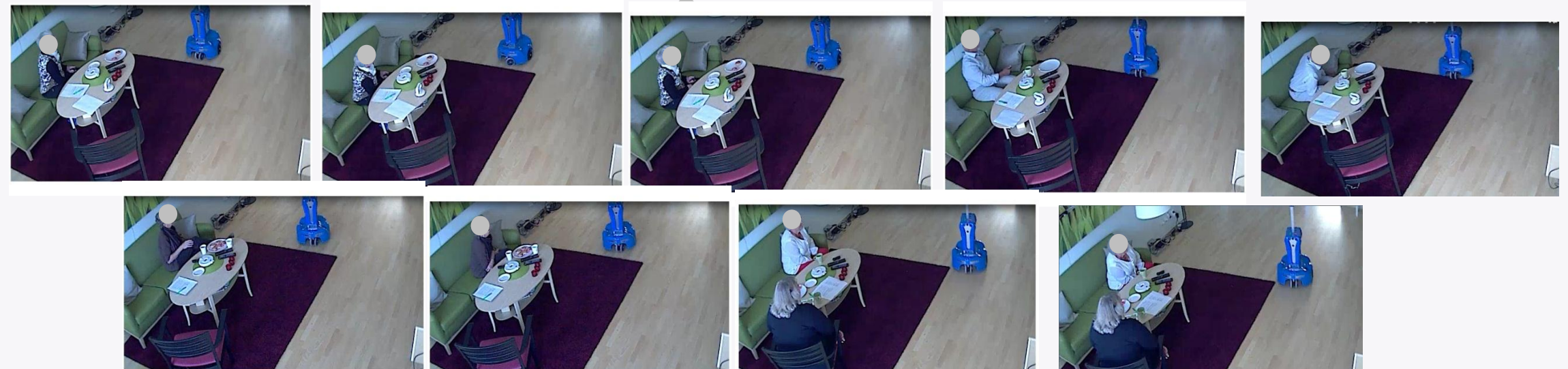

The elderly said that the height of Giraff needs to be adjustable to suit both sitting and standing conversations. It was perceived as being too high when having a sitting conversation but ok when standing. In the interviews, two of the elders expressed discomfort when Giraff drove ahead of the elder further enforcing the need of eye contact.

Ex 4 "It felt a bit strange when she had turned towards the table in the kitchen. I was instructed to go there but it felt weird to see her from the back so to say."

Ex 5 "She turns the back on me when leaving the bedroom. I do not know if she could possibly back out and keep interacting with me on the way out. Technically it should not really be a problem huh so that we can keep the eye contact."

When talking about different objects, the elderly reconfigured into new spatial formations which could be compared with the *L-shape*. Several of the ones experiencing the look-away formation in this type of scenario ended up in a *vis-a-vis* after such interaction.
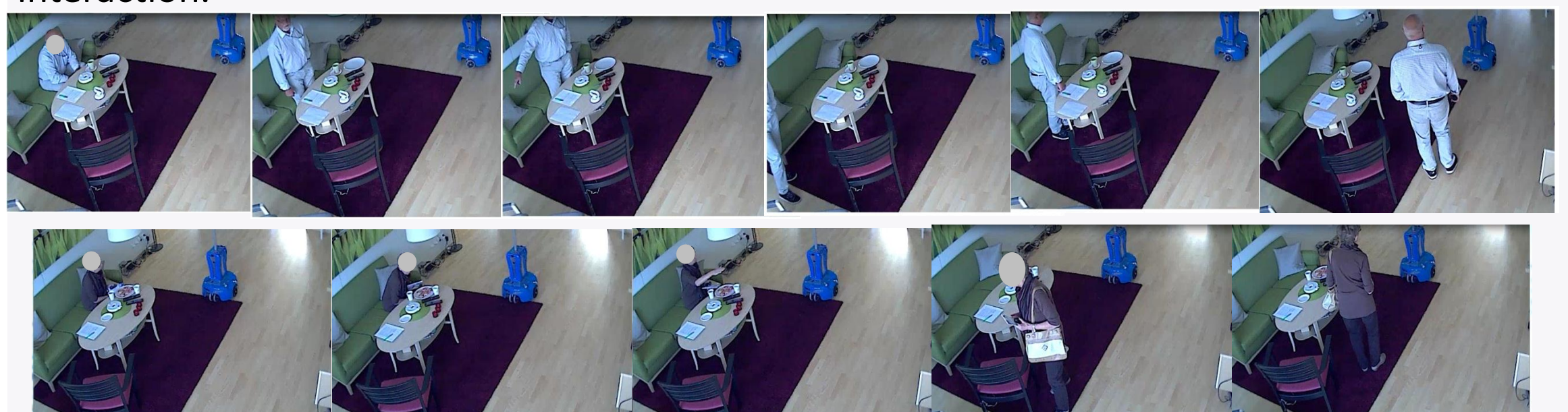
Concluding remarks The results in Experiment 2 indicate that the elderly prefer interactions in which the spatial configuration .is similar to the one in human-human interaction. However, these formations were not naturally formed by novice users in Experiment 1. As such, means for supporting the pilots in navigating Giraff properly when interacting with elderly may be needed.