Enhancing Social Collaboration in Human-Robot Teams

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Motivation

As we, robotics researchers, look to equip robots with skills that enable them to work well within human-robot teams, it is important that we focus on developing tools and algorithms for robots to enhance the group's social support. In our work, we (1) demonstrate our exploration of methods for a robot to strengthen social support within a human-robot group and (2) propose a multimodal sensing algorithm to detect relevant social dynamics within a human-robot group so that a robot can strengthen social support more strategically.

Exploring Methods of Shaping Social Support in Human-Robot Teams

Collaboration & Performance

Children who were asked **task-focused questions** by the robot had **higher performance scores** in a collaborative game than the children who were asked **relationship-focused questions** by the robot, however, had a **lower perception of their own performance** than the children who were asked relationship-focused questions by the robot.

Strohkorb, S., Fukuto, E., Warren, N., Taylor, C., Berry, B., & Scassellati, B. (2016). Improving human-human collaboration between children with a social robot. In *2016 25th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)* (pp. 551-556). IEEE.

Vulnerability & Trust

Human team members in a group with a robot making **vulnerable comments** as opposed to neutral comments were more likely to explain the mistake, console, and laugh with their fellow human team members in the aftermath of a team member's error in the game. This finding demonstrated **'ripple effects'** of the robots behavior.

Strohkorb Sebo, S., Traeger, M., Jung, M., & Scassellati, B. (2018). The ripple effects of vulnerability: The effects of a robot's vulnerable behavior on trust in human-robot teams. In *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 178-186). ACM.

Inclusion

In current work, we are interested in investigating which behavior strategies of a robot are most effective at **including a member of the human-robot team that feels excluded**.

Detecting Relevant Social Dynamics within Human-Robot Groups

We are building a model that takes as inputs real-time audio and video data from human group members and predicts the group's current level of social support by detecting backchannel behaviors using the below speaker and listener cues. Using this model, we plan on running a human subjects experiment where the model's results informs robot actions within a human-robot team to help improve social support.

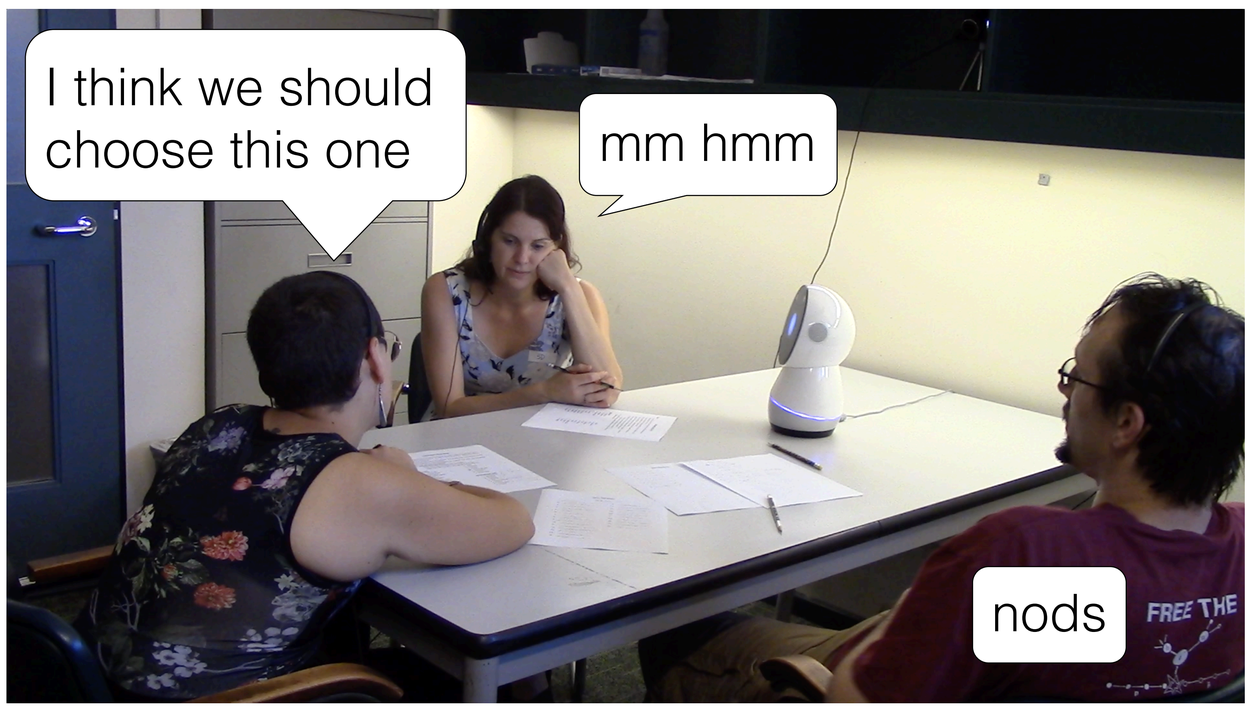
Speaker Cues:

- Eye Gaze
- Pitch / Intonation
- Energy / Intensity
- Speech Pauses
- Filled Pauses
- Long / Ending Utterances
- Vowel Volume
- Noise-to-harmonics

Listener Cues:

- Short utterances (e.g. "ok", "uh-huh", "yes")
- Laughter
- Smiles & Frowns
- Mouth Movement
- Eyebrow Movement
- Eye Gaze
- Head Nods & Movement

Speaker and listener cues taken from the supplementary materials from: Lee, J. J., Breazeal, C., & DeSteno, D. (2017). Role of speaker cues in attention inference. Frontiers in Robotics and AI, 4, 47.



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