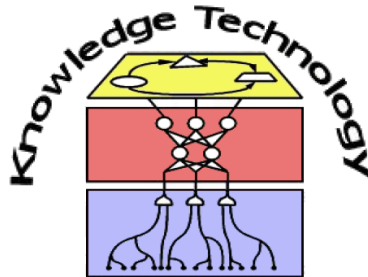


The Impact of Personalisation on Human-Robot Interaction in Learning Scenarios

Nikhil Churamani, Paul Anton, Marc Brügger, Erik Fließwasser, Thomas Hummel, Julius Mayer, Waleed Mustafa, Hwei Geok Ng, Thi Linh Chi Nguyen, Quan Nguyen, Marcus Soll, Sebastian Springenberg, Sascha Griffiths, Stefan Heinrich, Nicolás Navarro-Guerrero, Erik Strahl, Johannes Twiefel, Cornelius Weber and Stefan Wermter

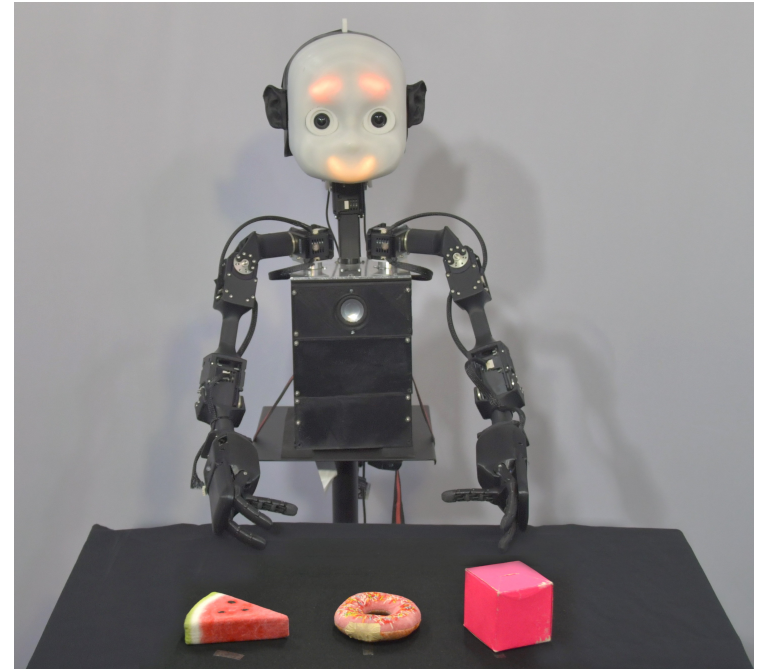
Knowledge Technology, Department of Informatics
Universität Hamburg



<http://www.knowledge-technology.info>

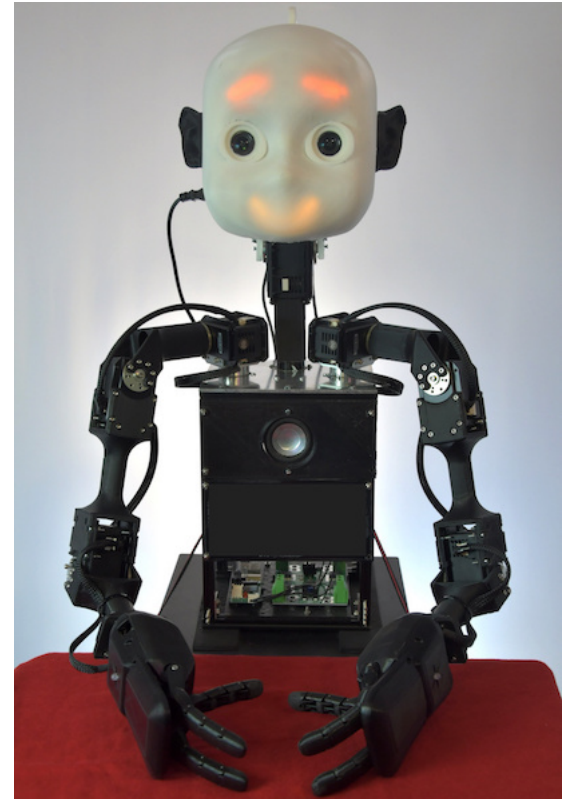
Motivation

- Neuro - Inspired COmpanion Robot (NICO)
 - Robot with Multi-modal capabilities for Human-Robot Interaction [Kerzel et al. 2017]
- Personalisation in Robots to increase their friendliness or social acceptance. [Saunders et al. 2016]
- “Humanoidly Speaking” Object Learning Scenario [Hinaut et al. 2015, Twiefel et al. 2016]



NICO

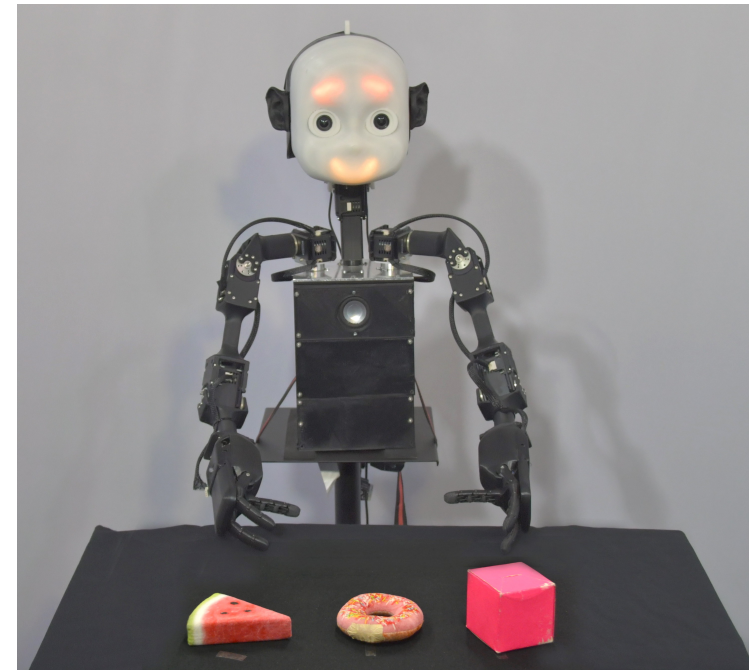
- Neuro-Inspired COmpanion robot
[Kerzel et. al., 2017]
- Mid-sized developmental robot.
- Built for Neuro-cognitive research
 - Kinetic arms
 - Stereo vision
 - Speech
 - LED facial expressions



“Humanoidly Speaking” Object Learning Scenario

[Hinaut et al. 2015, Twiefel et al. 2016]

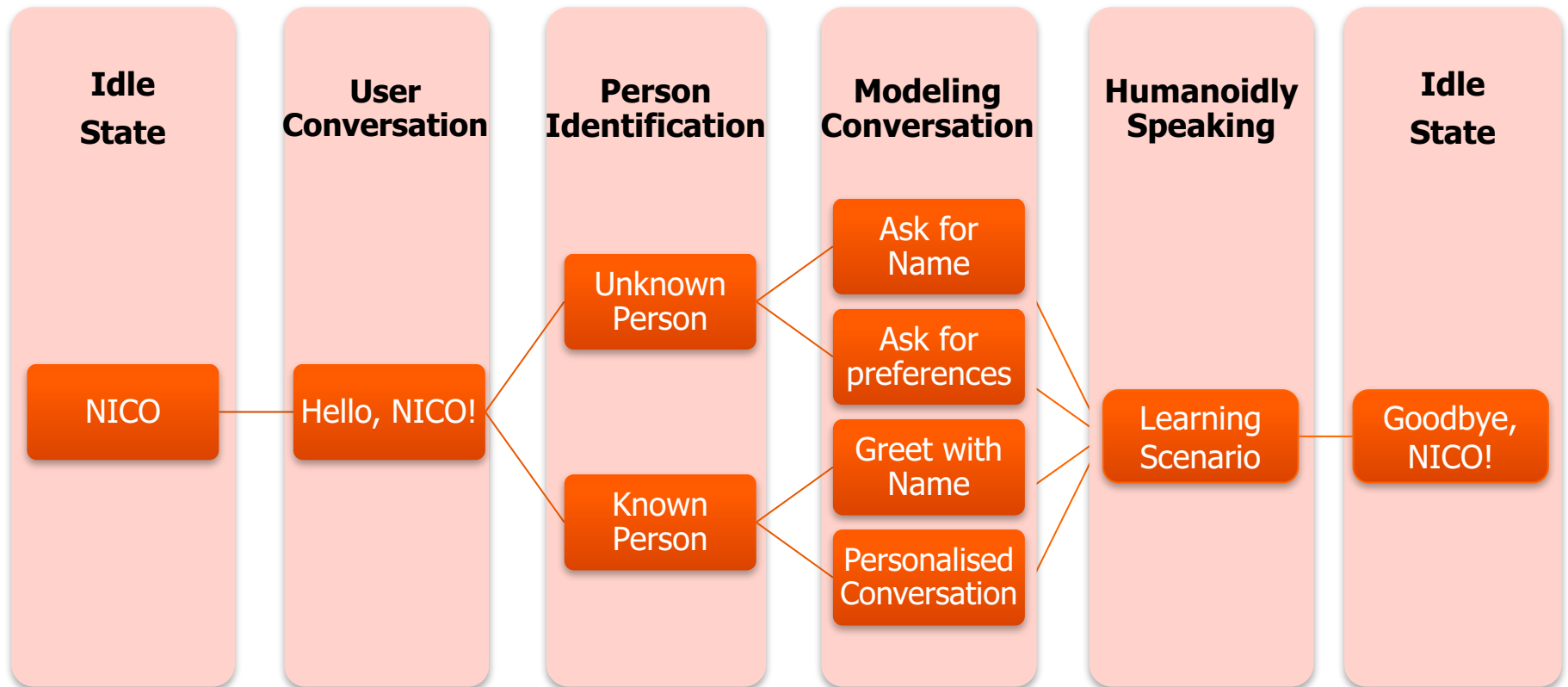
- Object Learning Scenario teaching objects using natural language.
 - Robot recognises different objects (pre-trained)
 - Object positions learnt relative to the robot (left, middle, right)
 - Recalls positions of the objects by pointing at them.



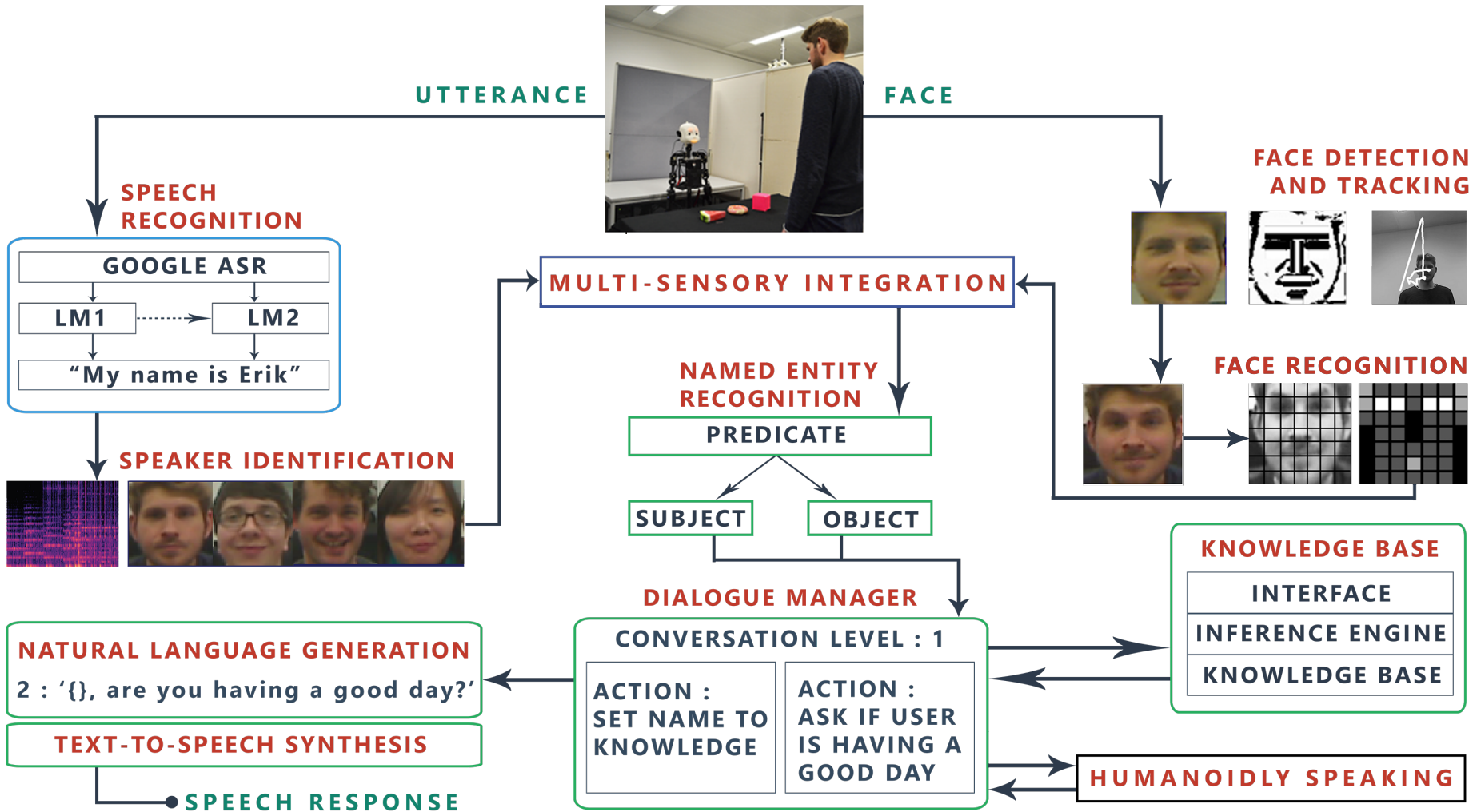
Research Question

“How do personalised interaction capabilities impact the perceived intelligence and social acceptance of an agent in learning scenarios?”

Interaction Scenario Description



Interaction Module: Implementation



Experiment

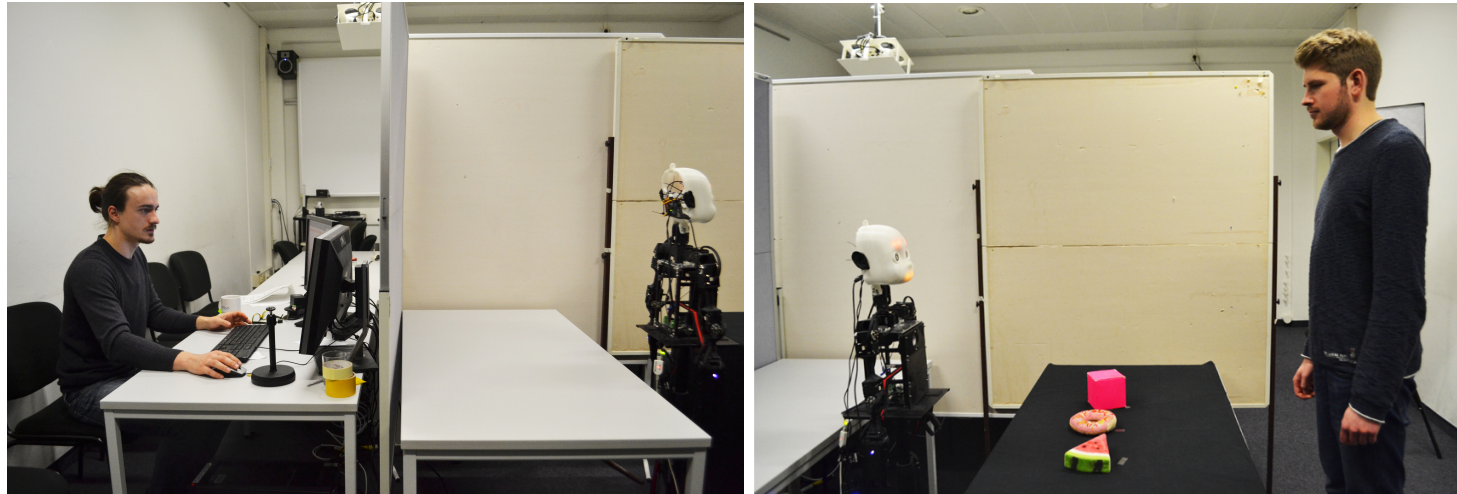
- Double Blinded random assignment of participants
 - “Basic” Humanoidly Speaking Scenario ($n=13$)
 - Interaction Scenario with Personalisation ($n=14$)
- Questionnaire
 - GODSPEED (for perceived intelligence) [Bartneck et al. 2009]
 - UTAUT (for social acceptance of technology) [Venkatesh et al. 2003]
 - MISC



Experiment Design

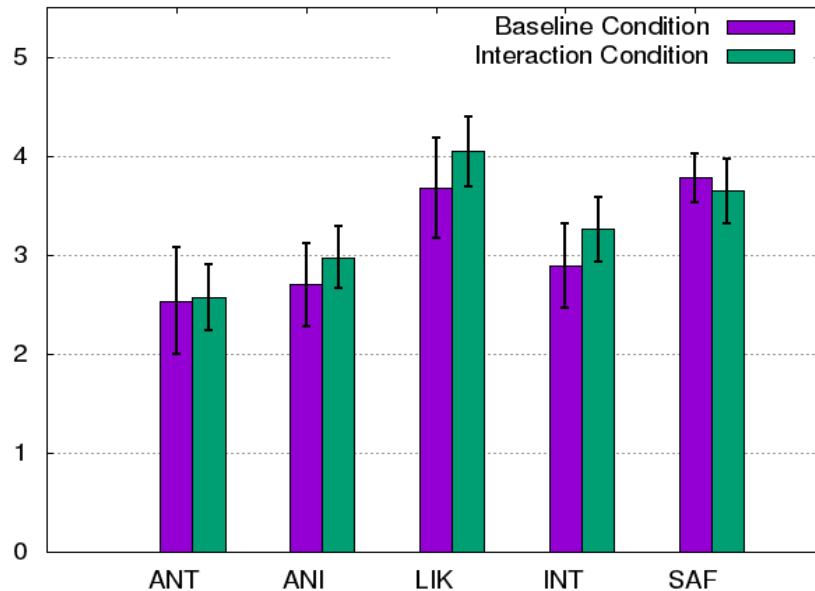
- The User is randomly assigned to one of the experiment conditions.
- Interaction 1:
 - NICO interacts with the user for the first time.
 - Depending on the *condition*, it asks for the user's name and other preferences.
 - User then teaches NICO, different objects.
- Interaction 2:
 - User returns to interact with NICO.
 - Depending on the *condition*, NICO recalls the user's name and models a conversation.
 - User then asks NICO to recall the objects learnt in the first condition.
- After the interactions, the user fills up the questionnaire.

Experiment Setup



Results – GODSPEED

GODSPEED average results



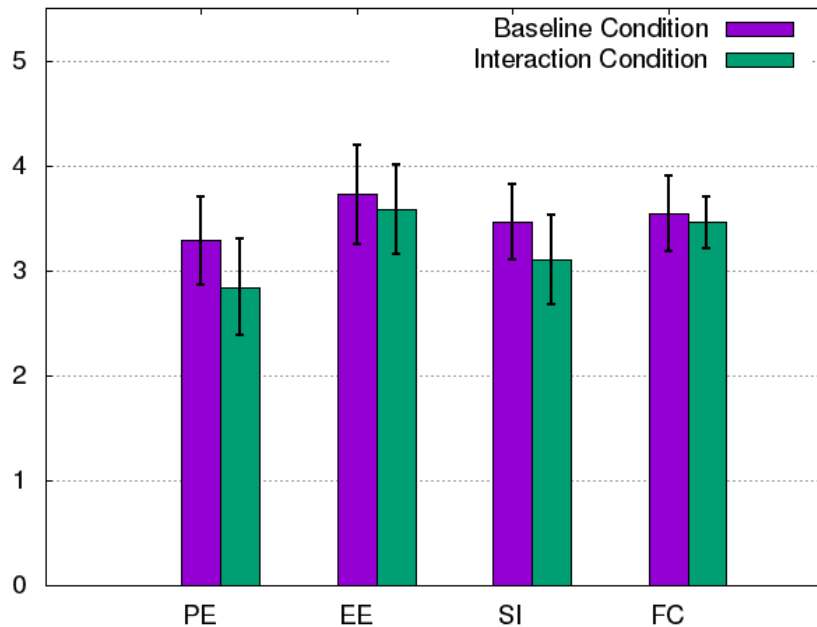
GODSPEED Dimension	Q^2	DoF	p -value
Anthropomorphism	8.9606	5	0.110
Animacy	6.0206	6	0.421
Likeability	12.7130	5	0.026
Intelligence	9.8482	5	0.079
Safety	9.1397	3	0.027

Test results for the Mann-Whitney U test on the GODSPEED Questionnaire.

ANT: Anthropomorphism, ANI: Animacy, LIK: Likeability, INT: Perceived Intelligence, SAF: Perceived Safety

Results – UTAUT

UTAUT average results



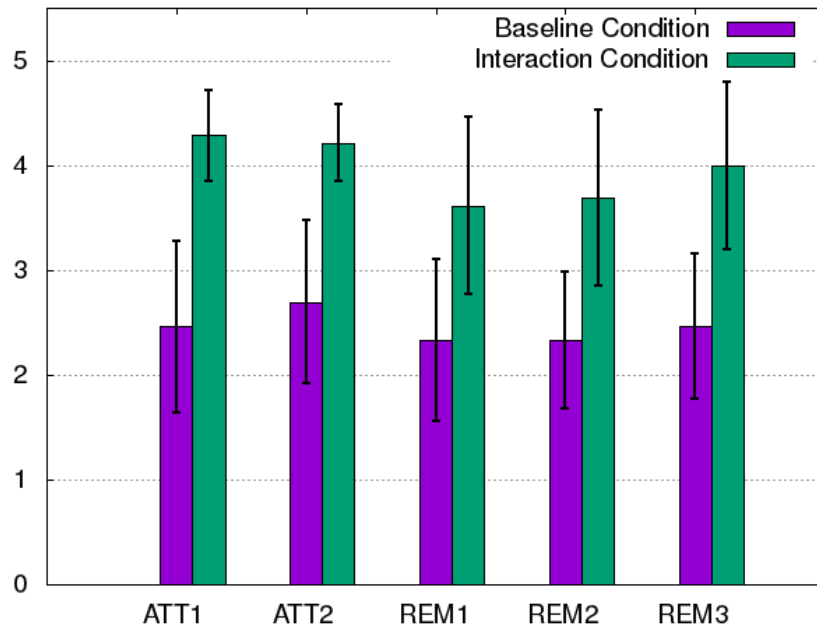
**PE: Performance Expectancy, EE: Effort Expectancy,
SI: Social Influence, FC: Facilitating Conditions**

UTAUT Dimension	Q^2	DoF	p -value
Performance Expectancy	4.4579	5	0.485
Effort Expectancy	5.9265	5	0.313
Social Acceptance	13.4710	5	0.019
Facilitating Condition	4.3774	5	0.496

Test results for the Mann-Whitney U test on the UTAUT Questionnaire.

Results – MISC

MISC questions average results



MISC Dimension	U	<i>p-value</i>
Pay Attention	33.5	0.002
Keep Engaged	35.5	0.002
Remember	42.5	0.025
Remember Next Time	37.5	0.013
Confidence remembering	33.0	0.003

Test results for uni-variate one-sided Wilcoxon-Mann-Whitney U test on the MISC Questionnaire.

ATT1: Pay Attention, ATT2: Keep Engaged, REM1: Remember, REM2: Remember Next Time, REM3: Remembering Confidence

Research Question

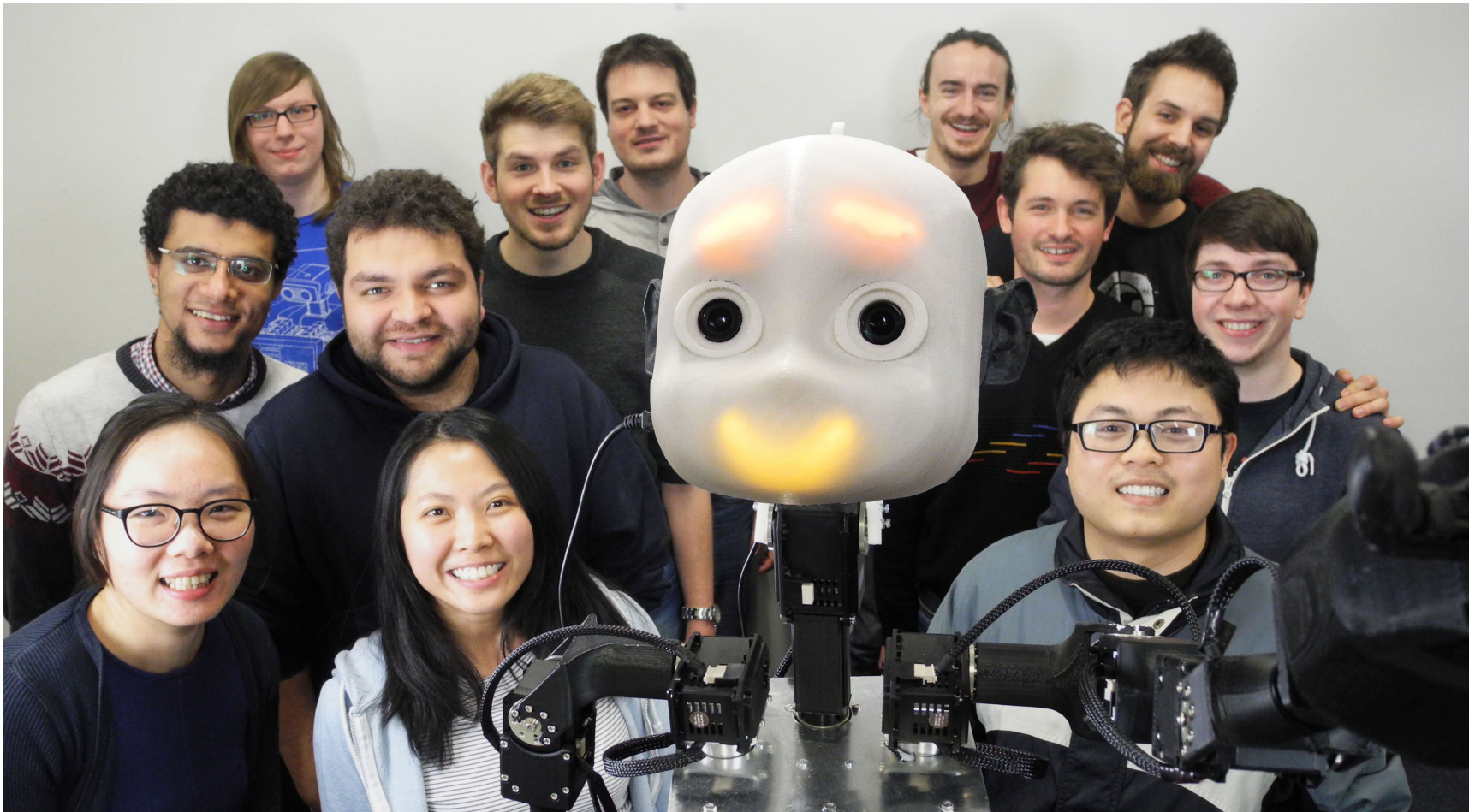
“How do personalised interaction capabilities impact the perceived intelligence and social acceptance of an agent in learning scenarios?”

Conclusion

- Learning Scenarios involve Humans interacting with agents.
- Enhanced and personalised communication capabilities make it more engaging. NICO achieves this by modelling a conversation.
- Autonomous interaction modelling, triggered by the user.
- Interactive agent is perceived more intelligent and likeable yet, users have reservations towards using it in real-world scenarios.
- Future Work:
 - Promising results which can be further substantiated by expanding the user study to a larger audience.

Q & A

<http://knowledge-technology.info>
Email: phri1617@informatik.uni-hamburg.de



References (I)

- Matthias Kerzel, Erik Strahl, Sven Magg, Nicolás Navarro-Guerrero, Stefan Heinrich, and Stefan Wermter. “*NICO – Neuro-Inspired COmpanion: A Developmental Humanoid Robot Platform for Multimodal Interaction*”. In *IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, pp. 728–731. IEEE, 2017.
- Joe Saunders, Dag Sverre Syrdal, Kheng Lee Koay, Nathan Burke, and Kerstin Dautenhahn. “*‘Teach Me - Show Me’ End-User Personalization of a Smart Home and Companion Robot*”. *IEEE Transactions on Human-Machine Systems* 46, pp. 27–40, 2016
- Xavier Hinaut, Johannes Twiefel, Marcelo Borghetti Soares, Pablo Barros, Luiza Mici, and Stefan Wermter. “*Humanoidly speaking–Learning about the world and language with a humanoid friendly robot*”. *International Joint Conference on Artificial Intelligence Video competition*, 2015.
- J. Twiefel, X. Hinaut, M. Borghetti, E. Strahl, and S. Wermter, “*Using Natural Language Feedback in a Neuro-inspired Integrated Multimodal Robotic Architecture*” pp. 52–57, 2016.

References (II)

- Hwei Geok Ng, Paul Anton, Marc Brügger, Nikhil Churamani, Erik Fließwasser, Thomas Hummel, Julius Mayer, Waleed Mustafa, Thi Linh Chi Nguyen, Quan Nguyen, Marcus Soll, Sebastian Springenberg, Sascha Griffiths, Stefan Heinrich, Nicolás Navarro-Guerrero, Erik Strahl, Johannes Twiefel, Cornelius Weber, and Stefan Wermter. “*Hey Robot, Why Don’t You Talk to Me?*”. In *IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*. In Press. IEEE, 2017.
- Christoph Bartneck, Dana Kulić, Elizabeth Croft, and Susana Zoghbi. 2008. “*Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots*”. *International Journal of Social Robotics* 1, 1 (2008), 71–81
- V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, “*User acceptance of information technology: Toward a unified view*” *MIS quarterly*, pp. 425–478, 2003.
- J. Twiefel, T. Baumann, S. Heinrich, and S. Wermter, “*Improving domain-independent cloud-based speech recognition with domain-dependent phonetic post-processing.*” in *AAAI*, pp. 1529–1536, 2014.