Ethical/Social Responsibility Issues in Social Robots

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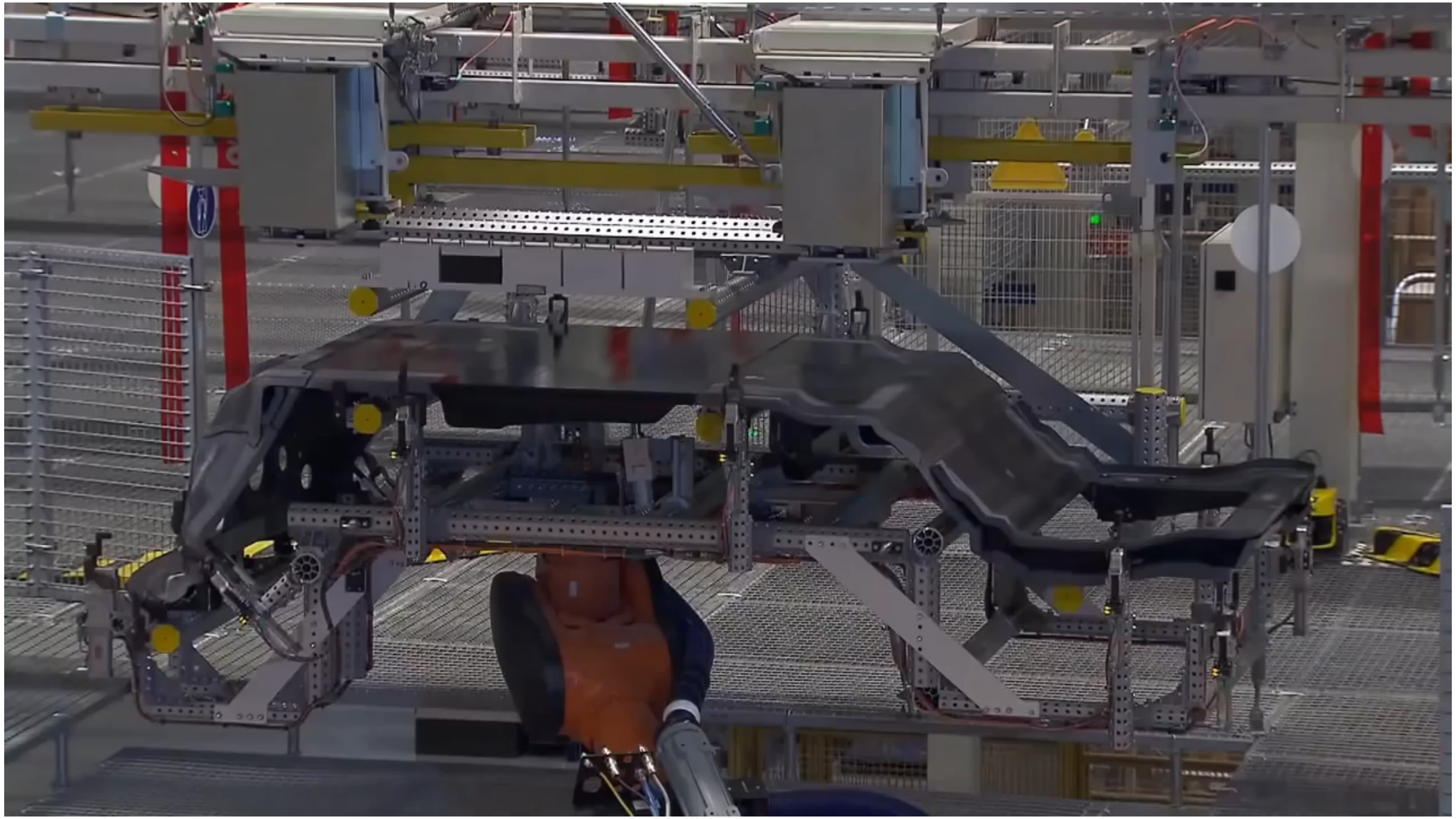
Automation



(KUKA)

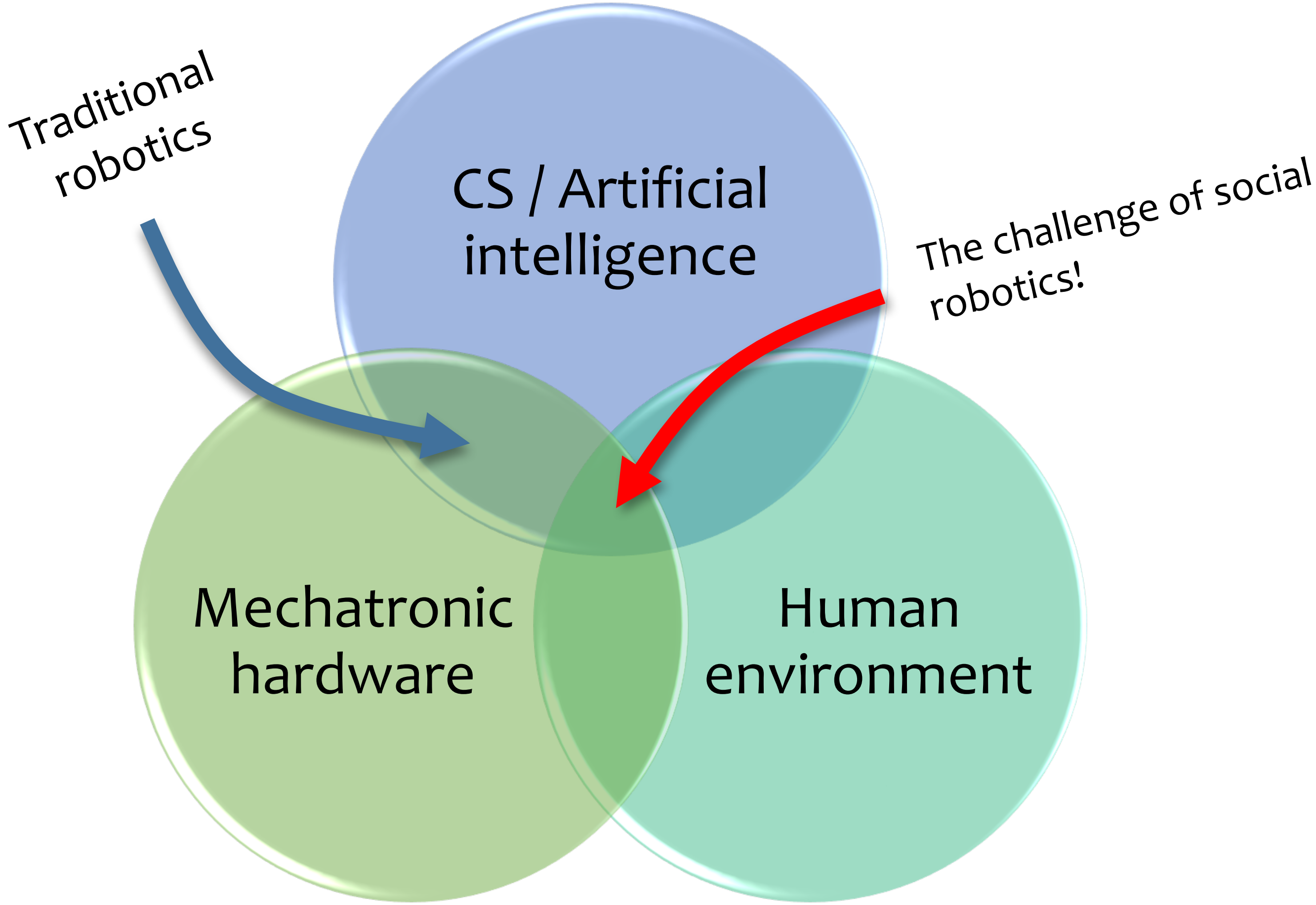
Self-driving vehicles

https://vimeo.com/192179727 (Tesla)

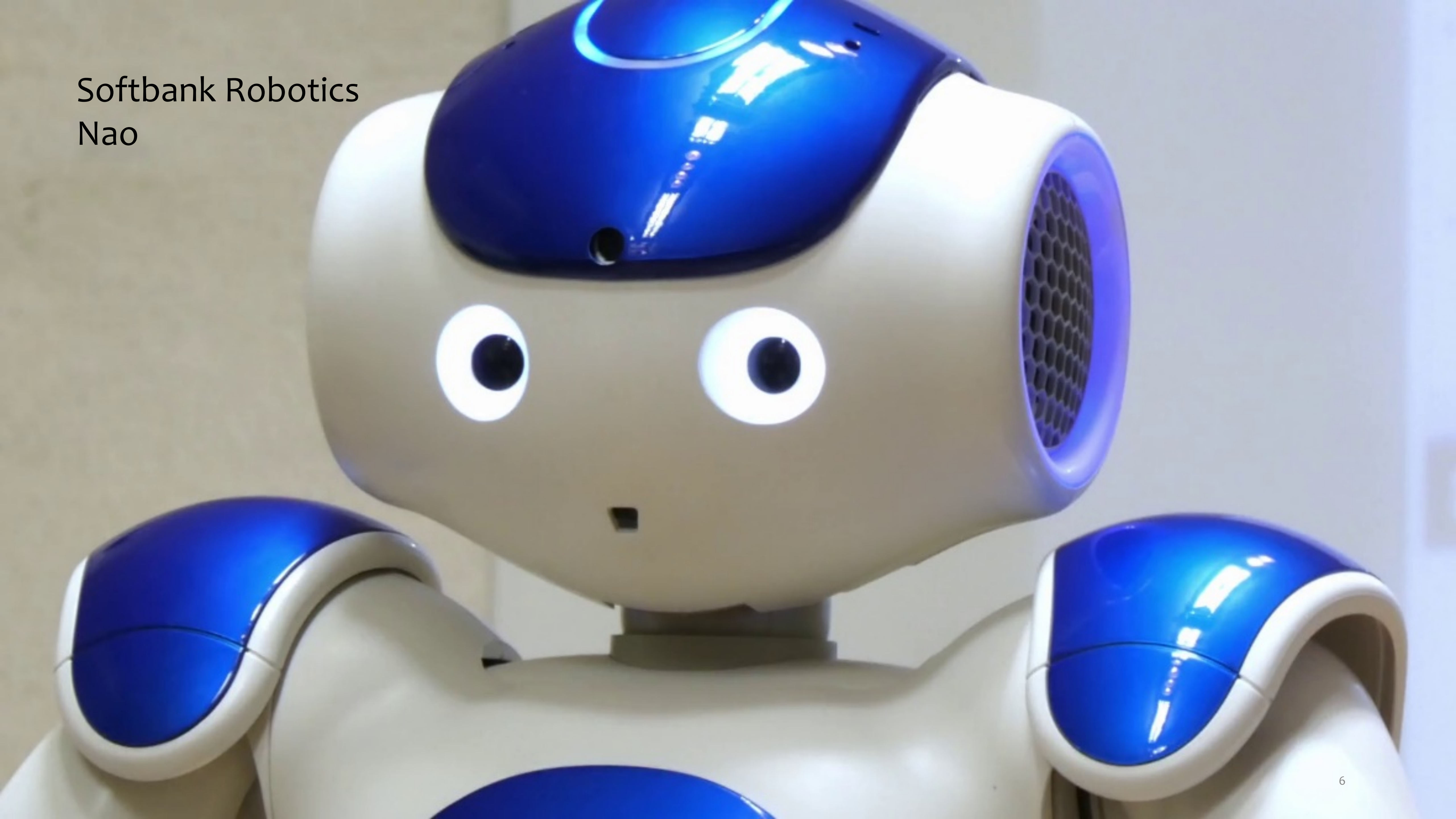
The robot spectrum

Physical — Social

Positioning social robotics



Softbank Robotics
Nao



BlueFrog
Buddy


Anki
Vector

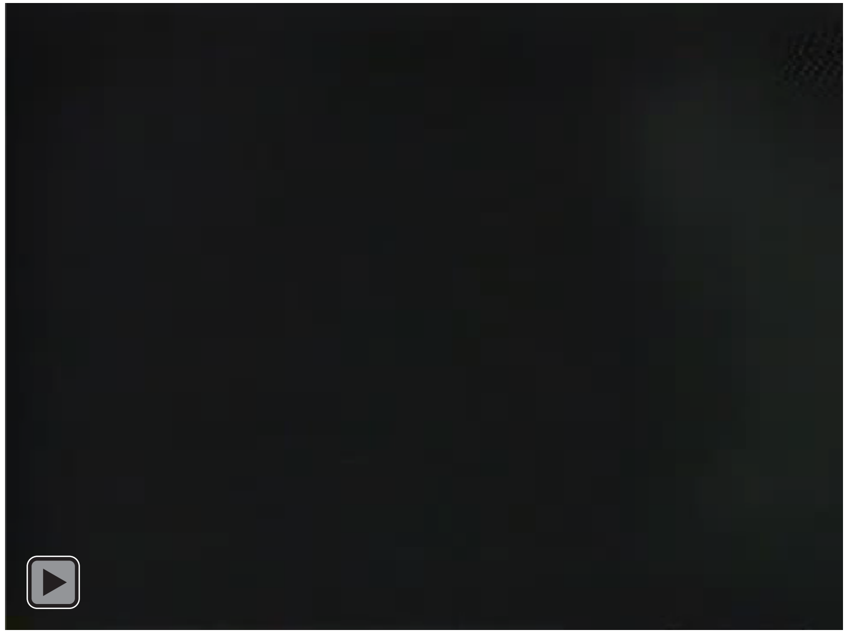
WooWee
KeepOn

Hanson Robotics
Sophia

Building social robots

Tapping into our social brain

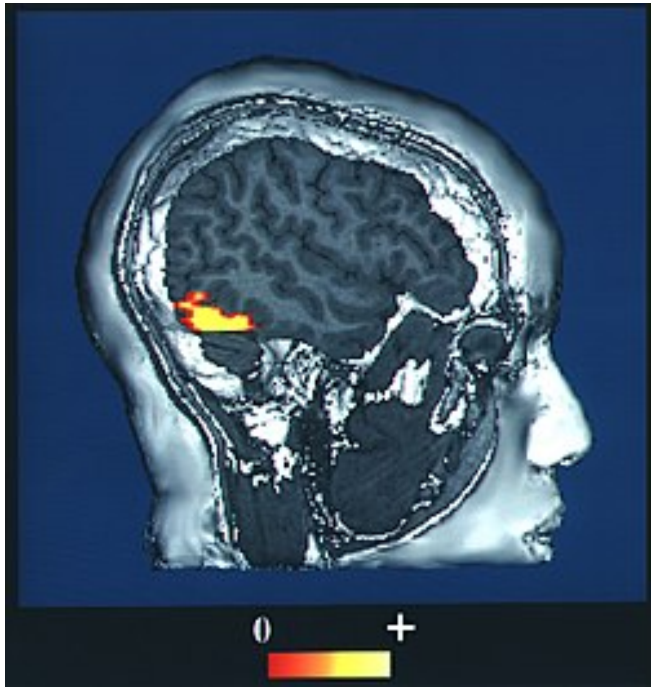
- We attribute human-like characteristics to artefacts.
- Social robots are designed to maximise this effect.
- Social robots can induce attention, compliance, conformity …



Heider, F., & Simmel, M. (1944). An experimental study of apparent behavior. *The American Journal of Psychology*, 243-259.

Pareidolia

- Perceiving human-like features in non-human stimuli.
- Evolutionary psychology explains pareidolia as an hyper response to face-like features.
- Better to respond to false positives than not respond to true positives.



Fusiform Face Area responds to seeing faces and to pareidolia experiences

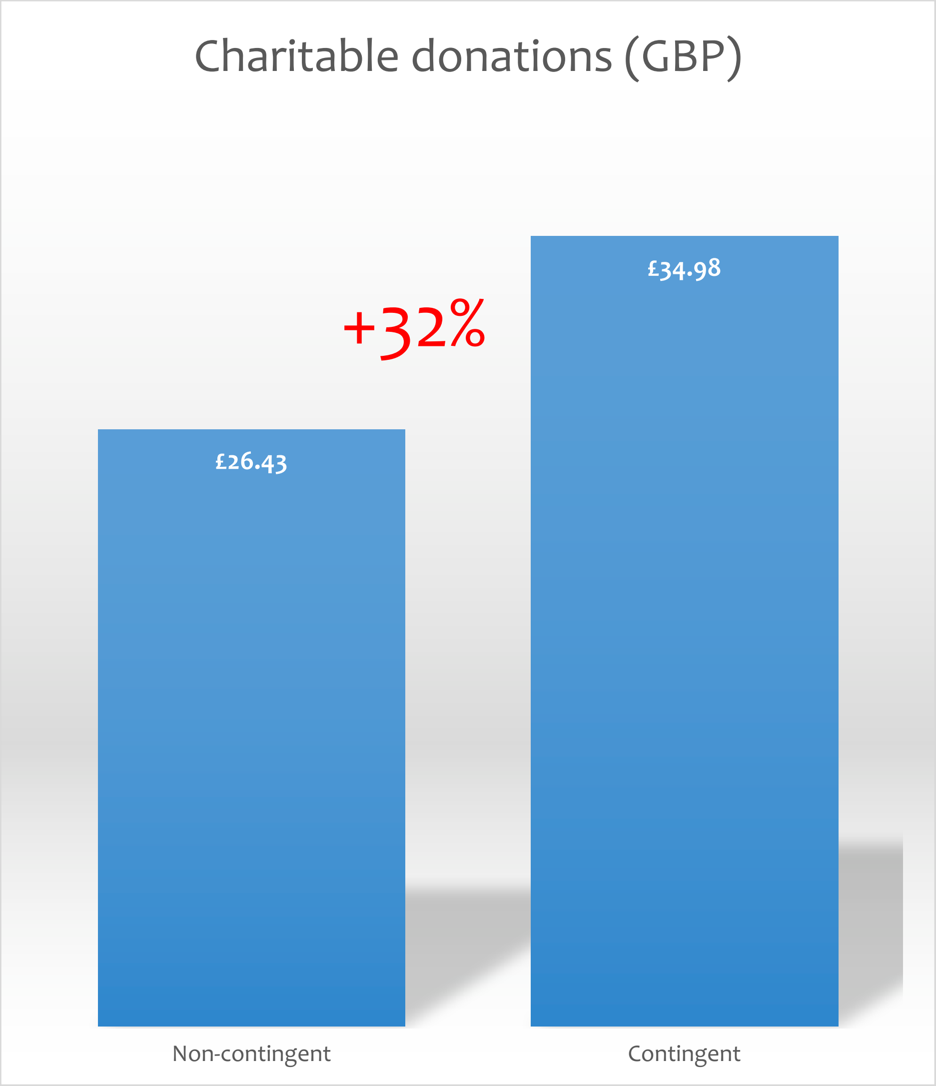
Gaze behaviour

- What difference does appropriate gaze behaviour make?

- Two conditions
  1. Correctly timed eye contact
  2. Avoiding making eye contact

- How much money will the robot collect for charity?

https://www.youtube.com/watch?v=j31Vaal5OeA (SociBot, EngineeredArts)



Charitable donations (GBP)
+32%
£26.43
£34.98
Non-contingent
Contingent

Application: Robots in education

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Changes in the educational landscape

- Changing demographics
- Greater diversity in the class room
- Shrinking school budgets
- More pupils per class room
- A need for personalisation

Robots for education

- Social robots can provide one-to-one tuition.
- They can achieve cognitive and affective outcomes.
- Their physical and social presence makes robot tutors effective.

SCIENCE ROBOTICS | REVIEW

HUMAN-ROBOT INTERACTION

Social robots for education: A review

Tony Belpaeme[1,2]*, James Kennedy[2], Aditi Ramachandran[3], Brian Scassellati[3], Fumihide Tanaka[4]

Social robots can be used in education as tutors or peer learners. They have been shown to be effective at increasing cognitive and affective outcomes and have achieved outcomes similar to those of human tutoring on restricted tasks. This is largely because of their physical presence, which traditional learning technologies lack. We review the potential of social robots in education, discuss the technical challenges, and consider how the robot's appearance and behavior affect learning outcomes.

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Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B., & Tanaka, F. (2018). Social robots for education: A review. *Science Robotics*, *3*(21), eaat5954.

The Journal of Genetic Psychology, 153(3), 269–273

Using a Personal Robot to Teach Young Children

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WANDA W. CLAYTON
Early Childhood Education Laboratory
Brigham Young University

ABSTRACT. Seventy-five preschool children were instructed about birds by a human teacher, a moving personal robot, a stationary personal robot, and a tape recorder. How much the children learned and how much attention the children paid were compared for each type of instruction. The children learned when they were taught by the human teacher and when they were taught by the animated and the stationary robots. The children paid more attention to the live teacher and to the moving robot than they did to the stationary robot or to the tape recorder. The difference between the amount of attention the children paid to the animated robot and the amount of attention they paid to the human teacher was not statistically significant.

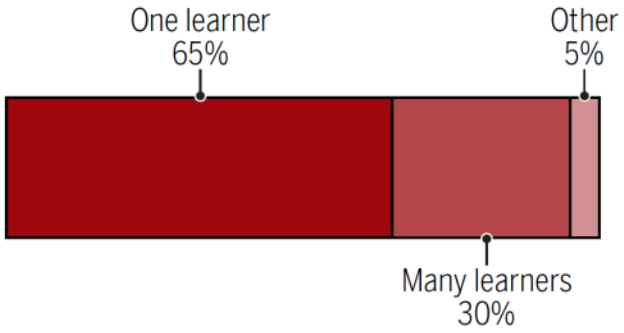
CHILDREN YOUNGER THAN 5 YEARS OF AGE learn differently from children older than 7 years of age. Young children's learning is more dependent on concrete, three-dimensional illustrations and social factors, such as personal liking of the teacher and animate teaching style, than is the learning of older children (Bredekamp, 1987; Taylor, 1985). Because of the special needs of young learners, many experienced teachers and early childhood education experts have expressed doubts about the value of computer-controlled presentations for teaching young children. Much of the high technology used with young children has been labeled developmentally inappropriate because it consists of messages requiring relatively sophisticated symbolic reasoning and hypothetical problem solving (Barnes & Hill, 1983; Brady & Hill, 1984; Cuffaro, 1984; Haugland & Shade, 1988; Tan, 1985; Zajonc, 1984).

In the present study, we attempted to use technology to teach young children in a manner that is more consistent with the tenets of developmental

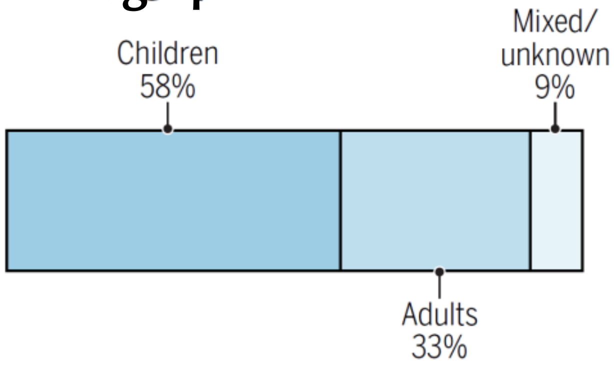
Address correspondence to Thomas W. Draper, Early Childhood Education Laboratory, Brigham Young University, Provo, UT 84602.

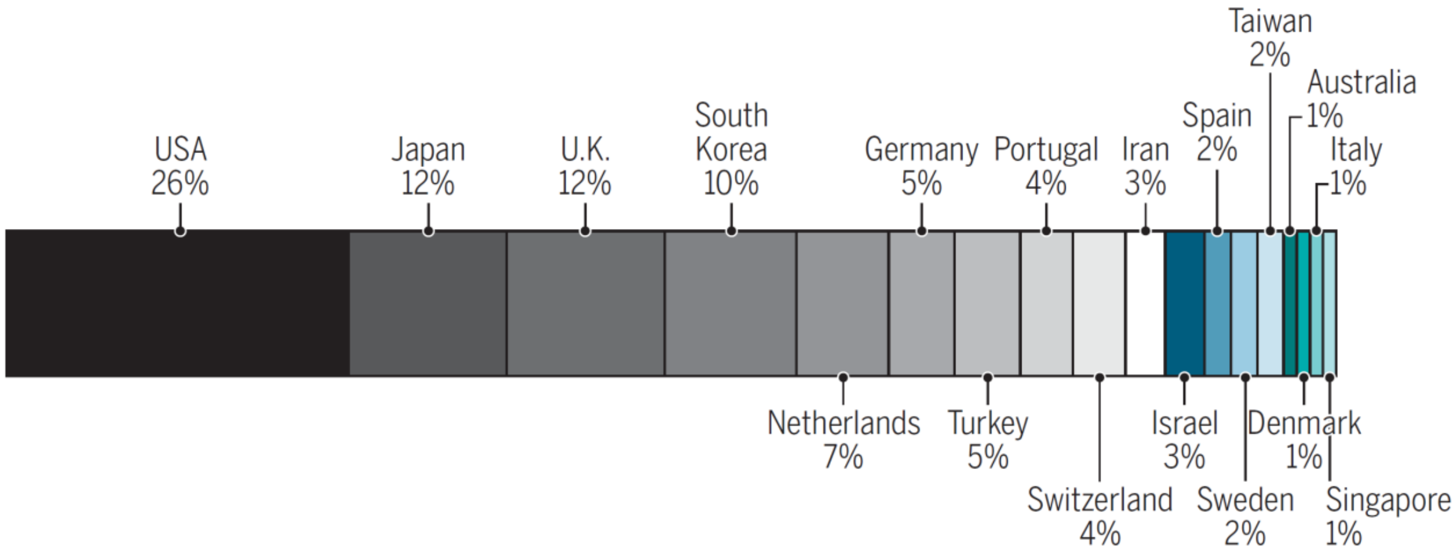
Overview

Number of learners per robot

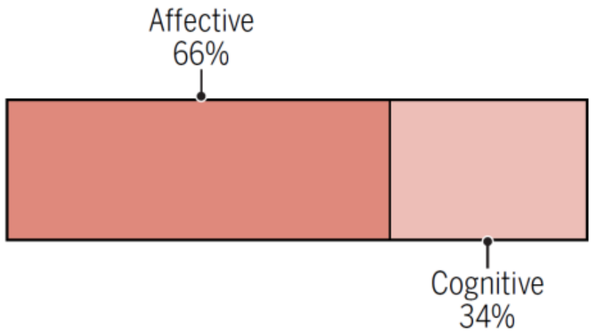


Demographics





Outcomes



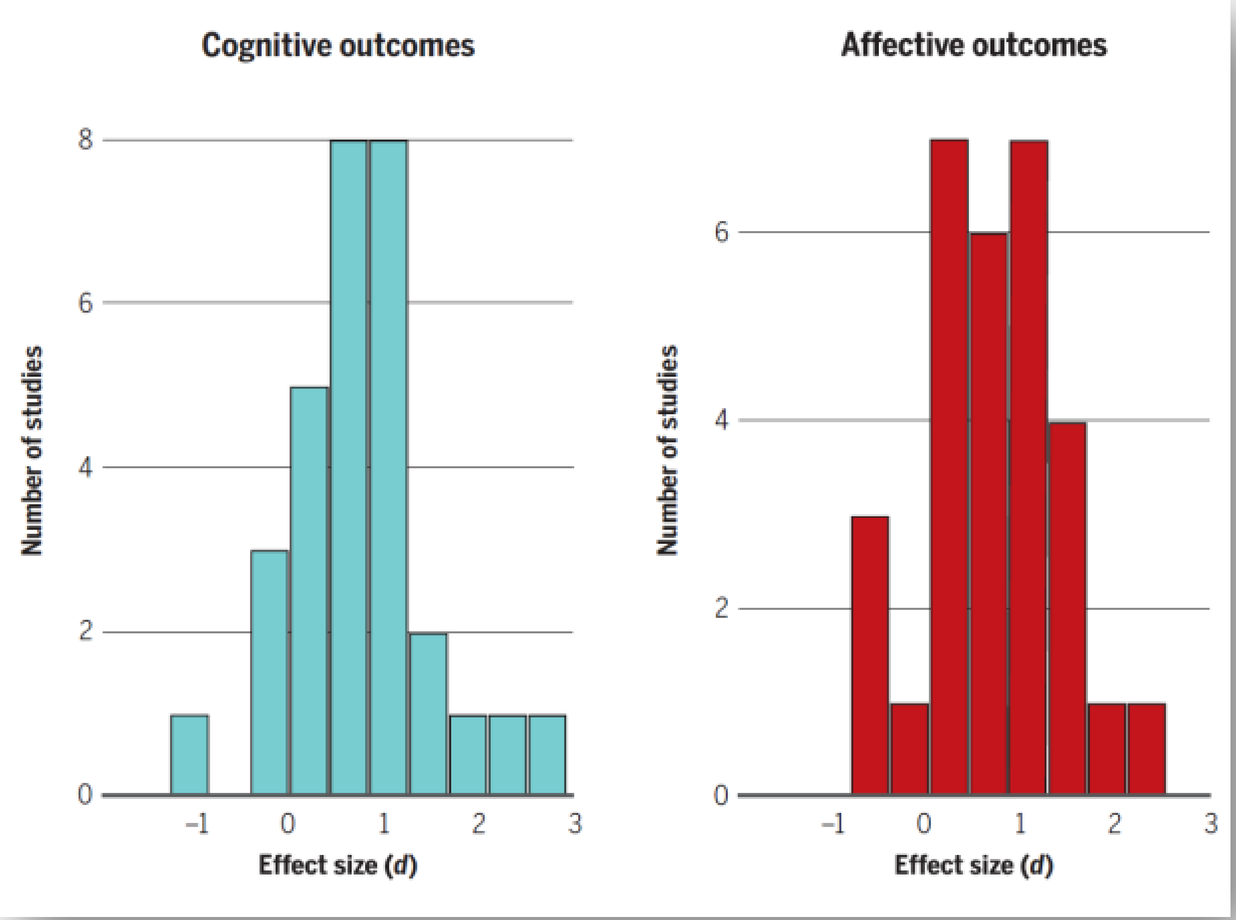
- **Cognitive:** learning gain, speed, …
- **Affective:** attitudes towards learning, the robot, …

Cognitive	Learning gain, measured as difference between pre- and posttest score
	Administer posttest either immediately after exposure to robot or with delay
	Correct for varying initial knowledge, e.g., using normalized learning gain (*77*)
	Difference in completion time of test
	Number of attempts needed for correct response
Affective	Persistence, measured as number of attempts made or time spent with robot
	Number of interactions with the system, such as utterances or responses
	Coding emotional expressions of the learner, can be automated using face analysis software (*47*)
	Godspeed questionnaire, measuring the user's perception of robots (*78*)
	Tripod survey, measuring the learner's perspective on teaching, environment, and engagement (*79*)
	Immediacy, measuring psychological availability of the robot teacher (*3*, *10*)
	Evolution of time between answers, e.g., to indicate fatigue (*31*)
	Coding of video recordings of participants responses
	Coding or automated recording of eye gaze behavior (to code attention, for example)
	Subjective rating of the robot's teaching and the learning experience (*15*)
	Foreign language anxiety questionnaire (*80*)
	KindSAR interactivity index, quantitative measure of children's interactions with a robot (*81*)
	Basic empathy scale, self-report of empathy (*82*)
	Free-form feedback or interviews

Effect sizes of outcomes

- Effect size Cohen's $d = \frac{\overline{x_2} - \overline{x_1}}{\sigma_1}$
  - 0.2 = small
  - 0.5 = medium
  - 0.8 = large

- 37 results compared a robot to alternative tech or human tutoring.
- **Cognitive *d* = 0.70**
- **Affective *d* = 0.59**
- Human tutor achieve cognitive outcomes of d = 0.79
- Positive affective outcomes do not mean positive cognitive outcomes, or vice versa.



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Robots for Language Learning

Learning languages

- Current classroom setup is ill-suited for language tuition
  - “Broadcast mode” of education doesn’t fit how people acquire first and second languages (or most other knowledge for that matter).
  - Social interaction is important for language acquisition.

- Children are very receptive to learning languages
  - Critical Period Hypothesis: learn a language before puberty.
  - Performance tails off after puberty (but contested).

- Migrant children benefit from personalised language tutoring
  - With potential long-term return on investment.

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Kuhl, P. K. (2010). Brain mechanisms in early language acquisition. Neuron, 67(5), 713-727.
Snow, C. E., & Hoefnagel-Höhle, M. (1978). The critical period for language acquisition: Evidence from second language learning. *Child development*, 1114-1128.

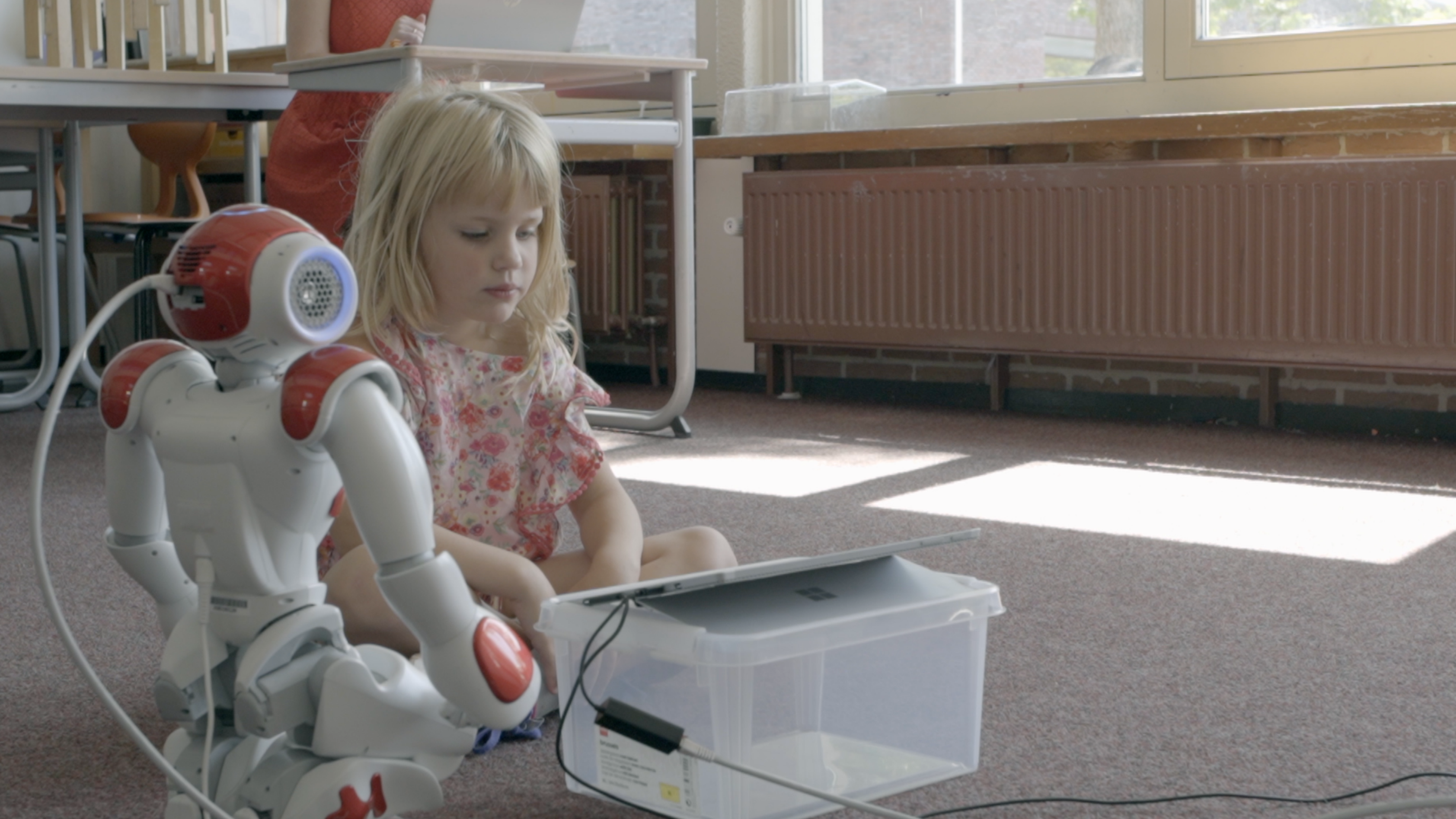
Possibly the greatest challenge of all

- Vocabulary learning works, beyond that things become very complicated.

- Conflicting age demands: start as early as possible, but interactions with the robot need older age due to their structure.

- Technical challenges prevent a dyadic conversation with the robot.
  - Speech recognition for children
  - Dialogue
  - Natural language processing in L1 and target language
  - Social signal processing

van den Berghe, R., Verhagen, J., Oudgenoeg-Paz, O., van der Ven, S., & Leseman, P. (2018). Social Robots for Language Learning: A Review. *Review of Educational Research*, 0034654318821286.



L2TOR is a European project that investigates how preschool children can learn a second language from a social robot.

https://www.youtube.com/watch?v=OQcWa3X-C54

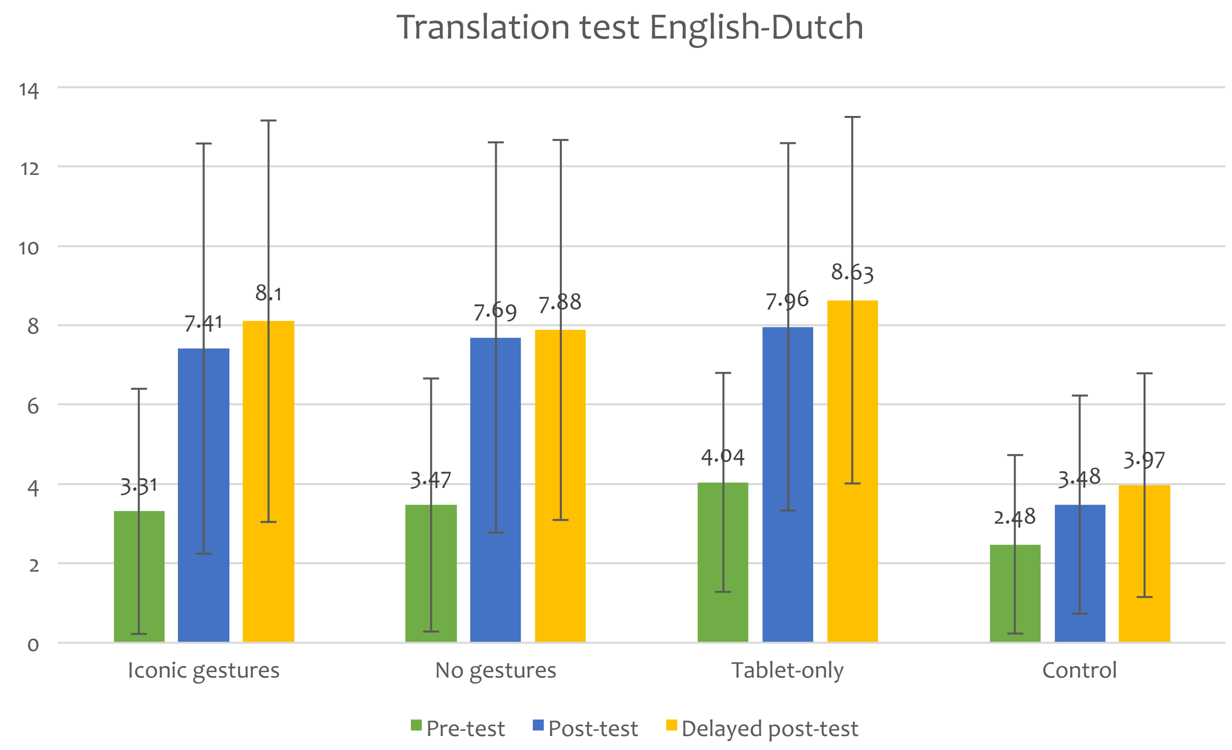
Large-scale study

- 208 children in 9 Dutch primary schools, 194 completed.
- Mean age = 5;8 (SD = 0;5), 34 English target words, embedded in grammatical context.
- 1 introduction, 7 learning sessions. Two months per child.
- Challenging words: space, number, actions
- Four conditions
  - Robot supports teaching with iconic gestures.
  - Robot does not gestures.
  - No robot, only tablet.
  - Control conditions.

Vogt, P., van den Berghe, R., de Haas, M., Hoffman, L., Kanero, J., Mamus, E., ... & Papadopoulos, F. (2019, March). Second Language Tutoring Using Social Robots: A Large-Scale Study. In *2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI)* (pp. 497-505). IEEE.

Results

- Learning progress is surprisingly slow.
- Children learn in all conditions, except in control condition.



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Compliance

Social conformity

- How much to people conform to social pressure?
- Two kinds of social pressure
  - Normative: influence by others
  - Informational: uncertainty, so you follow what the others are doing
- Solomon Asch's social conformity experiments (1951)

https://www.simplypsychology.org/asch-conformity.html

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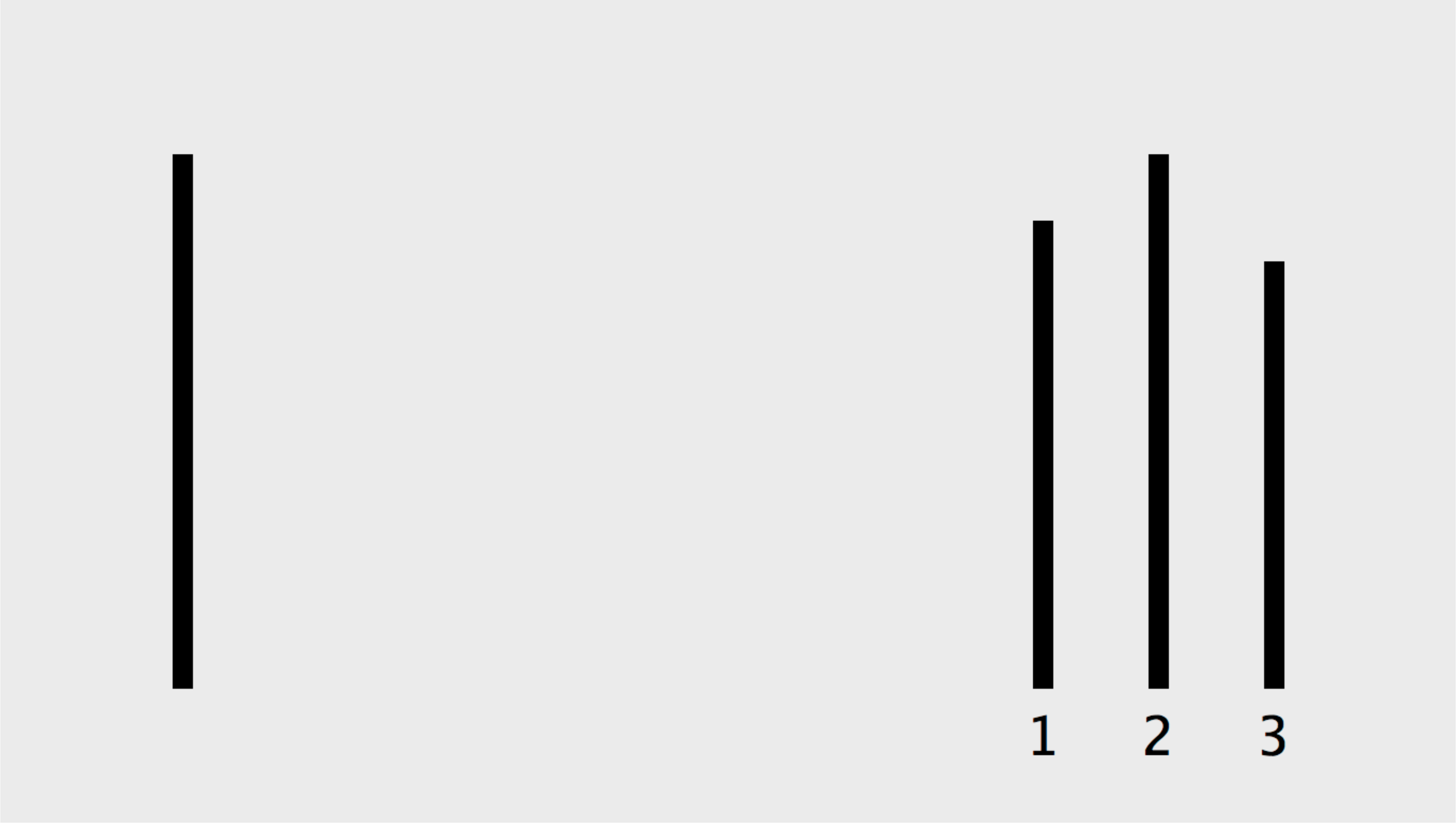
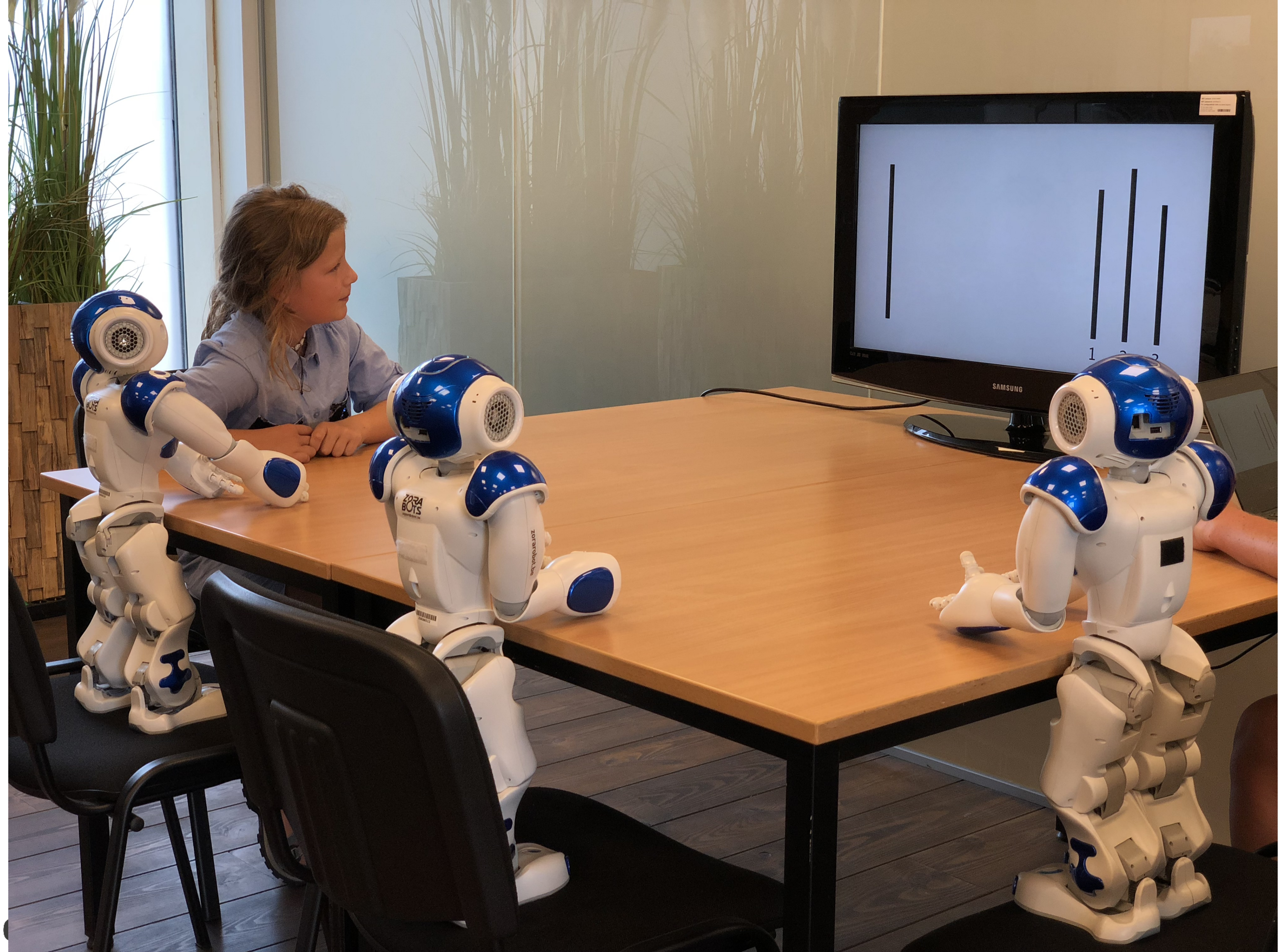
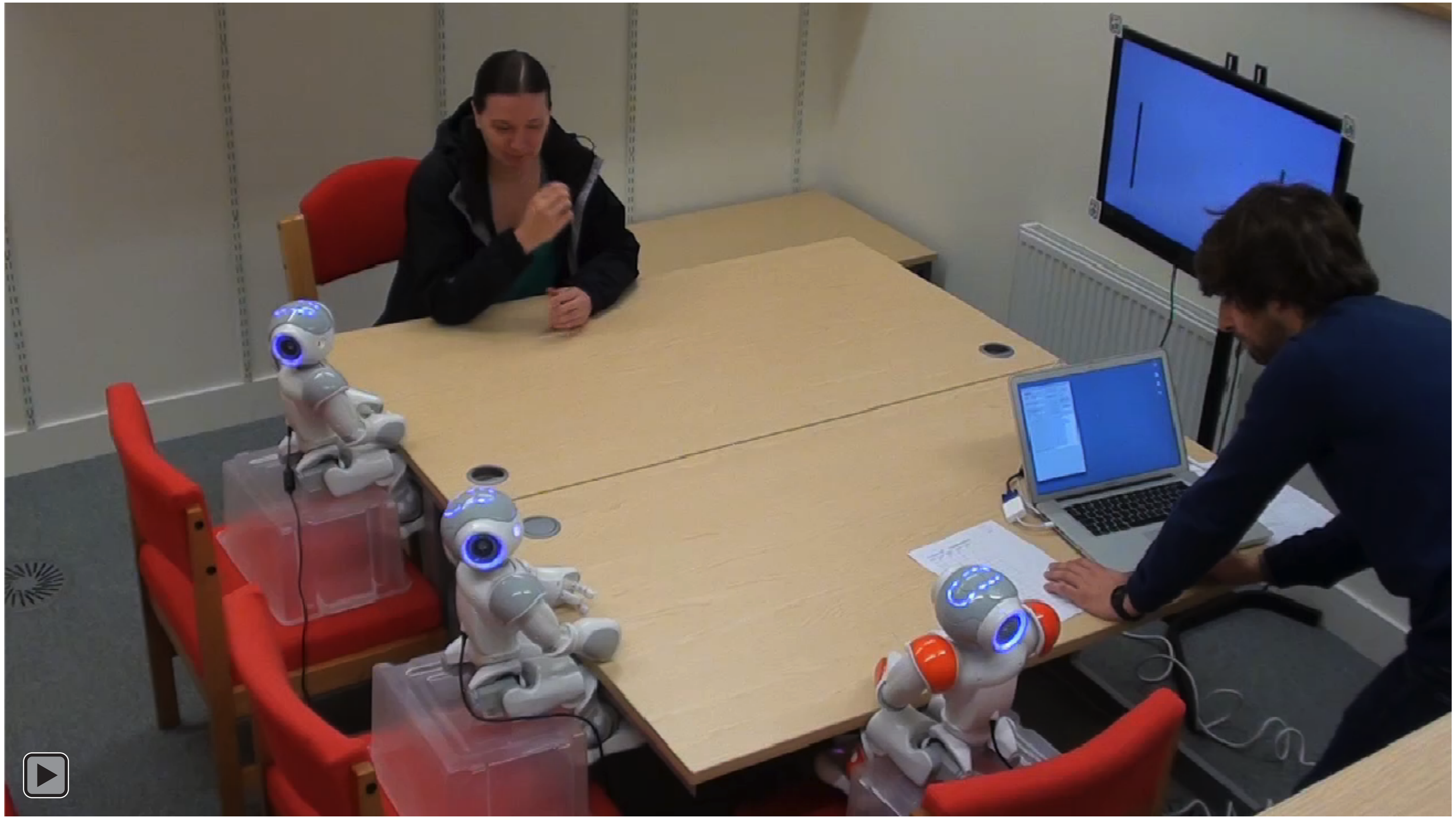
S. E. Asch, Effects of group pressure upon the modification and distortion of judgments, in *Groups, Leadership, and Men*, H. Guetzkow, Ed. (Carnegie Press, 1951), pp. 222–236 .


1 2 3

Social conformity

- Asch found that people succumb to peer pressure
  - When a wrong response was given by the group, in **32% of the trials people repeated the wrong response**.
- Would robots exert social peer pressure as well?


SAMSUNG



Method

- Each participants sees 18 “visual tests” called *trials*
  - 6 neutral trials: the others give the correct answer
  - 12 critical trials: the others give the wrong answer
- Participants
  - Adults: M_{age} = 31.0; SD = 14.2
  - Children: M_{age} = 8.5; SD = 0.54

- Five experimental conditions

1. Adult alone
2. Adult with robots
3. Adult with other adults
4. Child alone
5. Child with robots
6. ~~Child with other children~~

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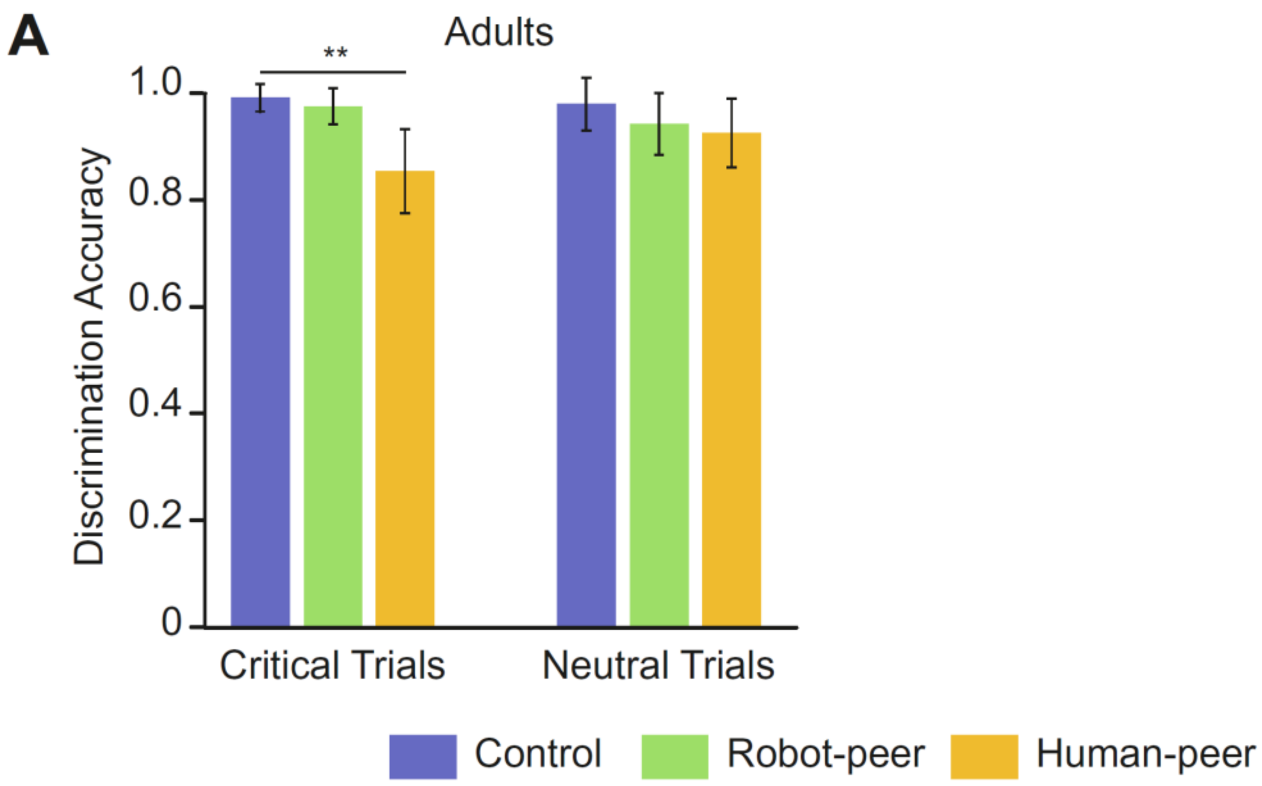
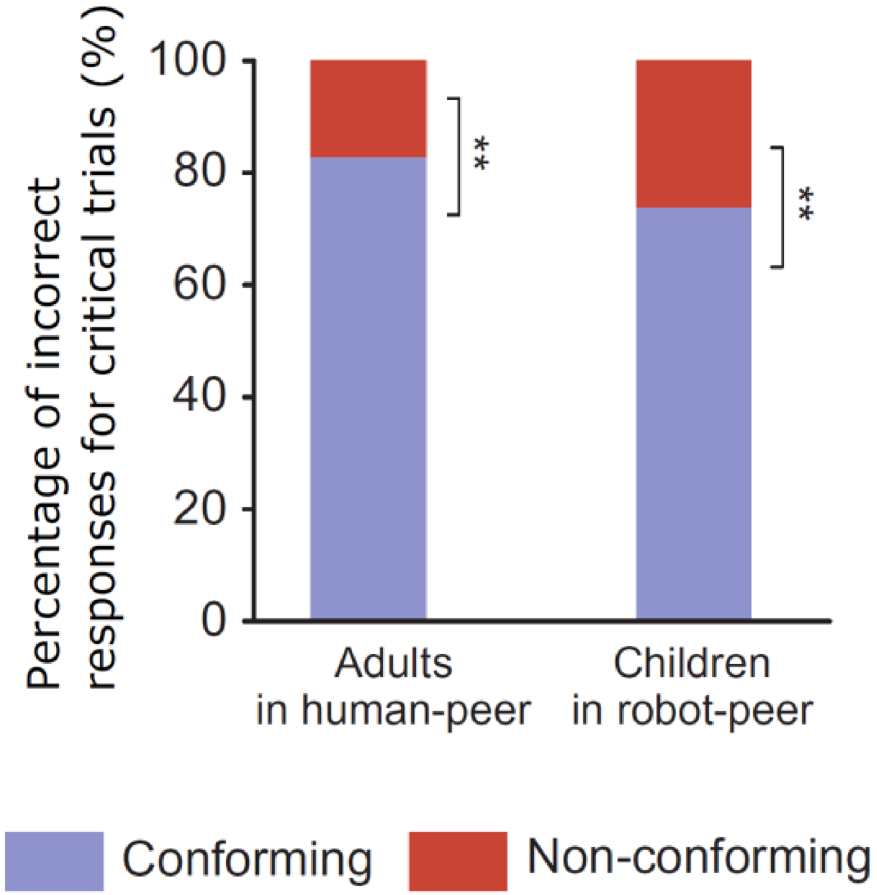
Results



** p < 0.00001, * p = 0.0009

Incorrect responses



** p < 0.001

Social conformity

- **Children conform to peer pressure by a robot group**
- **Adults do not**
- Results are likely to be influenced by appearance of the robot, how the robot is presented, and cultural norms.

Anna-Lisa Vollmer, Robin Read, Dries Trippas, and Tony Belpaeme (2018) Children conform, adults resist: A robot group induced peer pressure on normative social conformity, *Science Robotics* , 3(21), eaat7111.


Shut the door on tailgating.
Use your access card when entering.

Tailgating with robots

- Can a social robot convince people to give it access to a secure building?

- Setting
  - A dual use building with ground floors open to public, top floor belonging to high tech R&D company.
  - Staff at the building trained to not give access to anyone without correct credentials and challenge all who attempt to enter the building.

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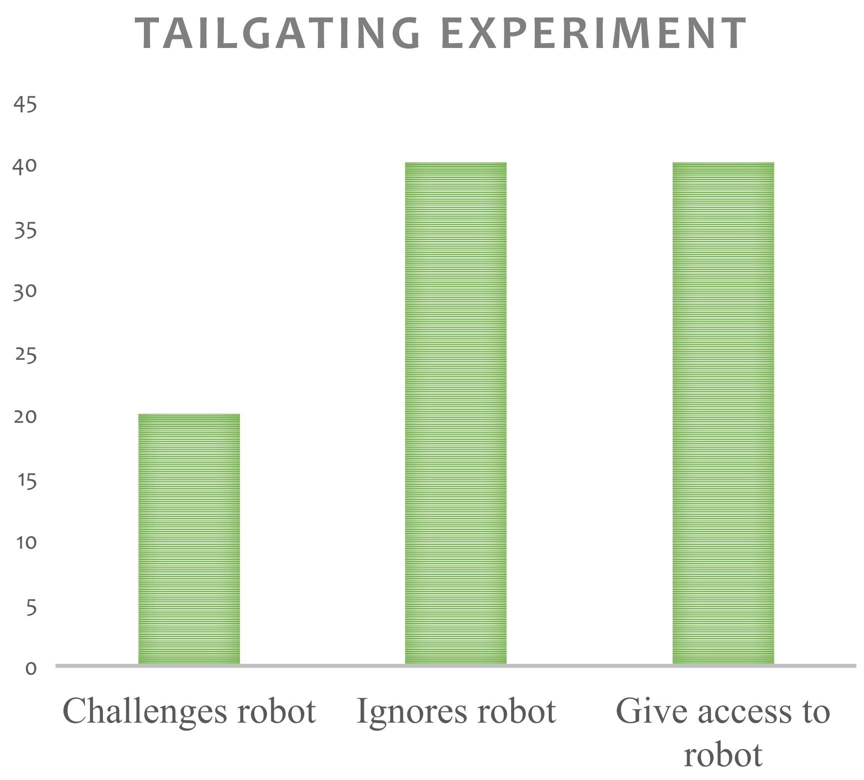
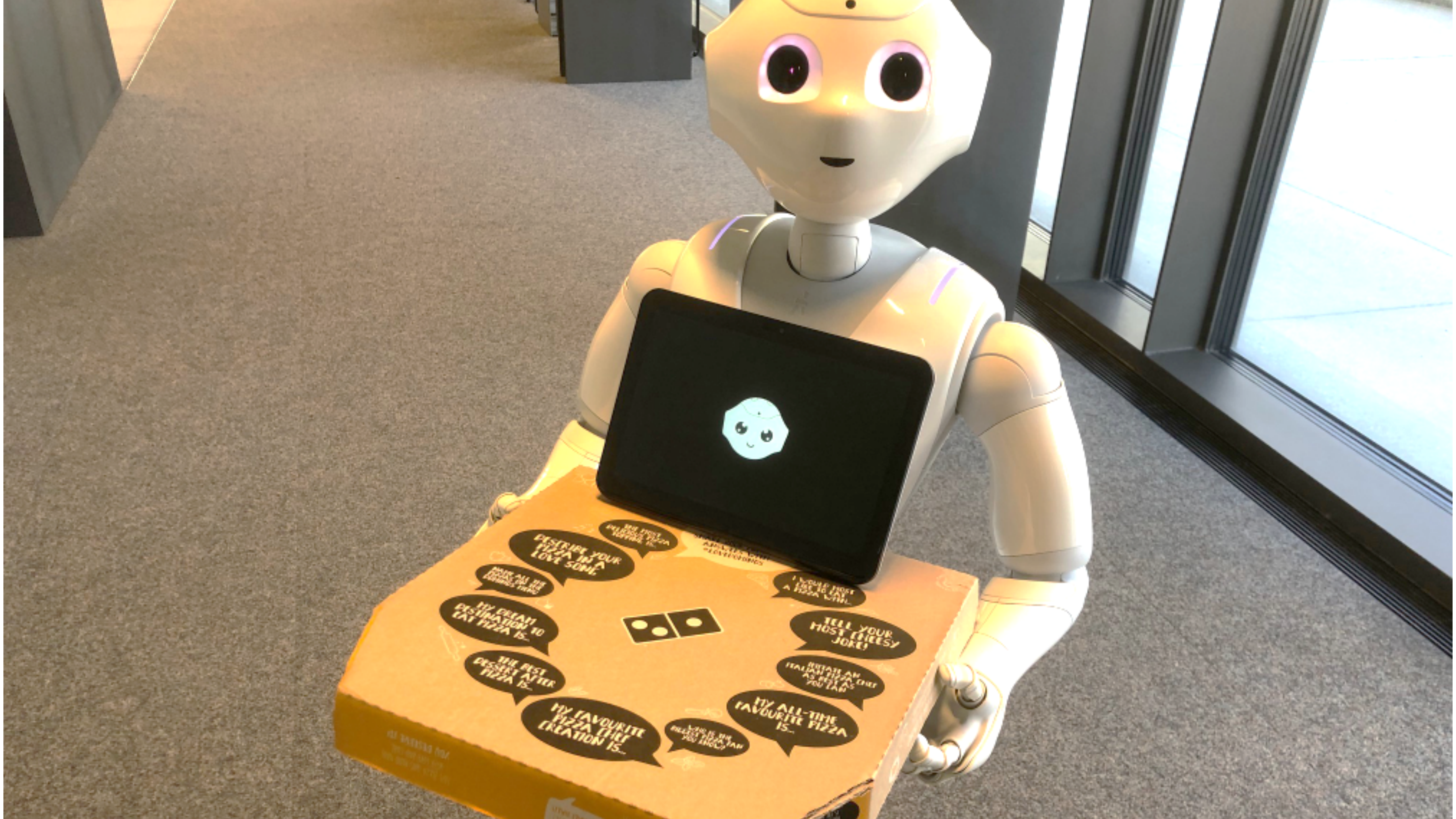
Tailgating proof of concept results




DESCRIBE YOUR PIZZA IN A LOVE SONG
MY DREAM DESTINATION TO EAT PIZZA IS...
THE BEST DESSERT AFTER PIZZA IS...
MY FAVOURITE PIZZA CHEF CREATION IS...
TELL YOUR MOST CHEESY JOKE!
MY ALL-TIME FAVOURITE PIZZA IS...

Autism Spectrum Disorders

- Significant social, communication and behavioural challenges.
- People with ASD may communicate, interact, behave, and learn in ways that are different from most other people.
- In the US, 1 in 68 children has been identified with ASD.
- ASD is about 4.5 times more common among boys.

Therapy

- Applied Behavioural Analysis (ABA) or Cognitive Behavioural Therapy (CBT) is the most used and only recognised ASD therapy
- Practising social skills, such as joint attention, imitation, turn taking
- Stimulus → behaviour → reward

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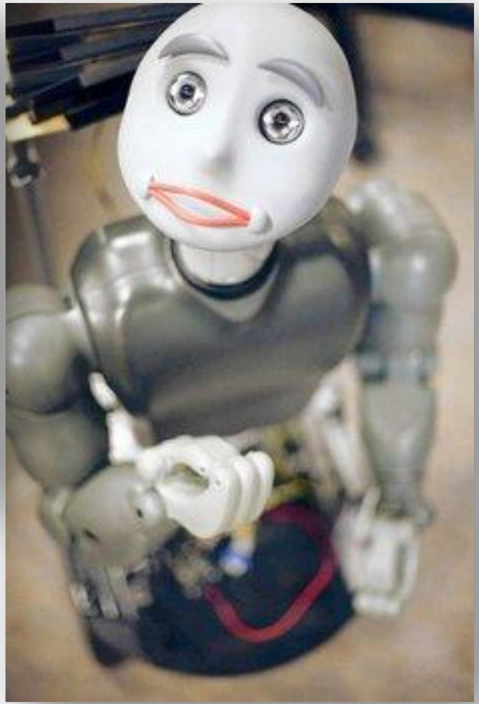
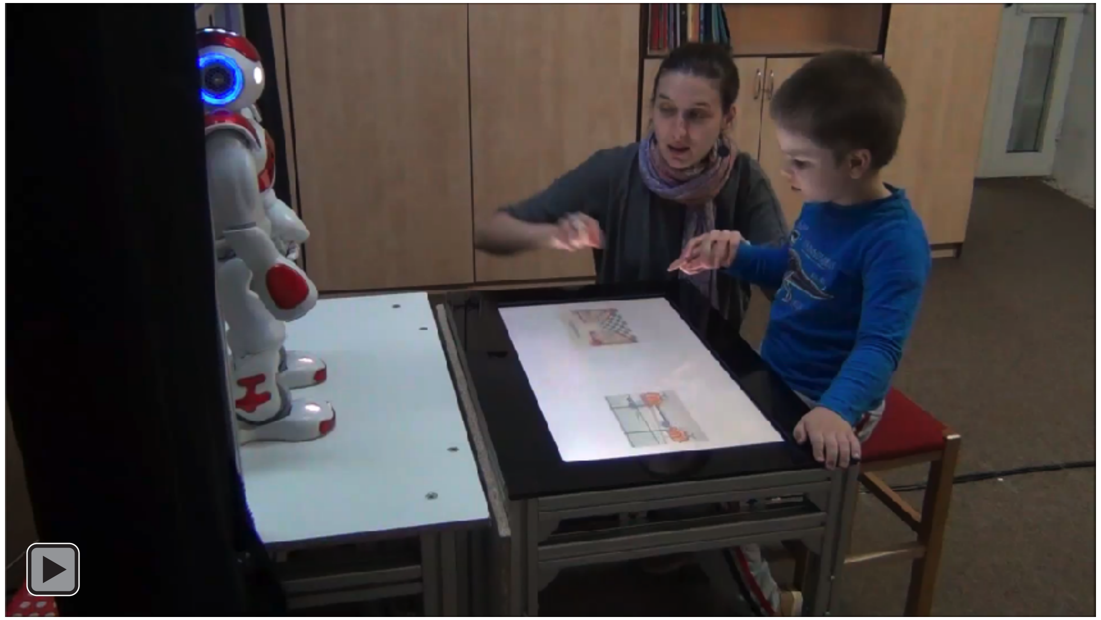
Robots and ASD



Dautenhahn, Mataric, Scassellati, Belpaeme/Thill/ Vanderborght, Kozima, …

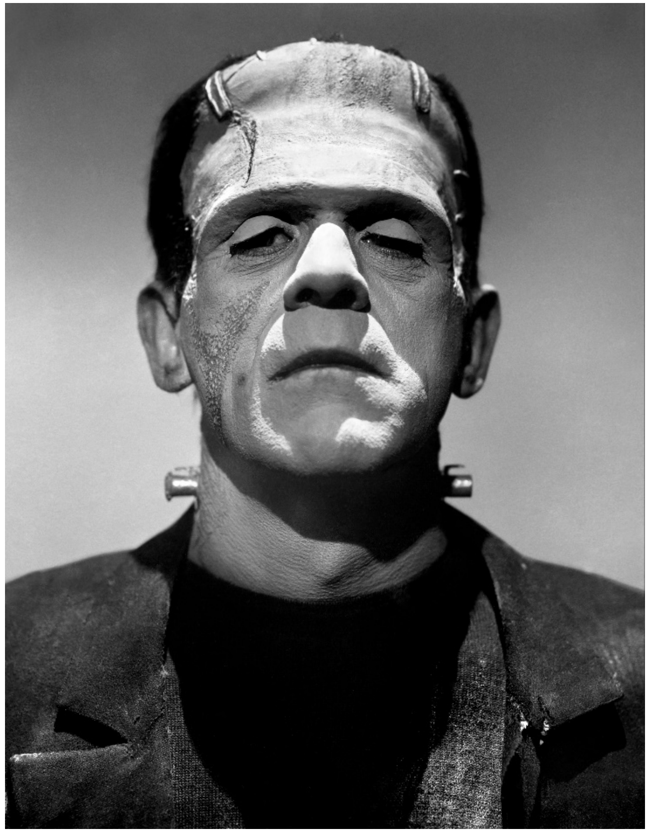
Robot therapy

- Lots of interest in robots, but weak evidence on their efficacy
- We tested 75 children, for a total of 3872 therapy sessions.
- **Results indicate that robot therapy is as good as classic therapy**
- **But, children more motivated with robot**



Social robots and ethics: the public

- The Western public perception of AI and robots is a mix between fascination and horror.
    - Western dystopian narratives.
    - Tropes such as "computers/AI/automation/robots will take our jobs"
    - Misplaced focus on trolley cart problems and their infinite variations.
- But teachers, nurses, therapists, carers are generally optimistic about the potential of social robots.



Kennedy, J., Lemaignan, S. and Belpaeme, T. (2016) The Cautious Attitude of Teachers Towards Social Robots in Schools. In Proceedings of the Robots 4 Learning Workshop, at IEEE RO-MAN 2016.

Social robots and ethics: legislation

- Robots are **embodied** information technology.
- Ability to manipulate the **physical and social world.**
- Privacy legislation and AI legislation initiatives apply to robots as well: **robots are not special**.

Social robots and ethics: social actors

- Robots are artificial systems but also **social actors.**
- While robot emotions and affection are artificial, they are not perceived as artificial by people.
- UK Engineering and Physical Sciences Research Council **Principles of robotics** (2010)
  - “Robots are manufactured artefacts. They should not be designed in a **deceptive way to exploit vulnerable users**; instead their machine nature should be transparent.”
- EU High-Level Expert Group on AI (2019)
  - “… AI system encourages humans to **develop attachment and empathy** towards the system” is framed as negative

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Stroke rehabilitation

- Case study: 8 y. old, cerebral stroke
- Lost mobility in right leg, arm and partial mobility in face
- Patient in the Neurology Department
- Medical staff suggested use of robot


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Thank you…

Paul Baxter, Jorre Deschuyteneer, James Kennedy, Séverin Lemaignan, Djamari Oetringer, Robin Read, Dries Trippas, Anna-Lisa Vollmer, Pieter Wolfert

and the ALIZ-E, DREAM and L2TOR project members.

Adaptive Strategies for Sustainable Long-Term Social Interaction

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