Hello, SIR
Introduction to
Socially Intelligent Robotics

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Goal & Learning Objectives

Goal:

- The goal of this lecture is to introduce you to social robots

Learning Objectives:

- Able to explain what robot interaction problem is
- Able to explain what social interaction is
- Able to explain what a social robot is
- Able to explain what artificial (social) intelligence is
- Able to explain some key choices in social robot design space

Our main character

Acting Like a Robot (Ulrike Quade Company, UU, VU)

COURSE ORGANIZATION

Introducing the Teachers

Koen Hindriks

1996: PhD on Agent Programming Languages Utrecht University

2000: Consultant at accenture

2005: Assistant Prof. AI Radboud University Nijmegen

2006: Assist. & Assoc. Prof. Interactive Intelligence TU Delft

2016: CEO, CIO, Co-Founder Interactive Robotics

2018: Professor Social AI VU

Research Interests

- Cognitive agent programming
- Conversational agents
- Social AI
- Social robots
- Socially aware systems

Introducing the Teachers

Kim Baraka (www.kimbaraka.com)

2016: Master in Robotics — Carnegie Mellon THE ROBOTICS INSTITUTE

2020: PhD in Robotics — Carnegie Mellon THE ROBOTICS INSTITUTE; TÉCNICO LISBOA

2021: Post-doc (Socially Intelligent Machines) — TEXAS The University of Texas at Austin

2021: Assistant Prof. (Social AI) — VU UNIVERSITY AMSTERDAM

Research Interests

- Human-robot interaction (HRI)
- Interactive robot learning
- Socially assistive robotics
- HRI x performing arts

Also has a contemporary dance background

Introducing the Teachers

Mike Ligthart

2016: Master in AI — Radboud University

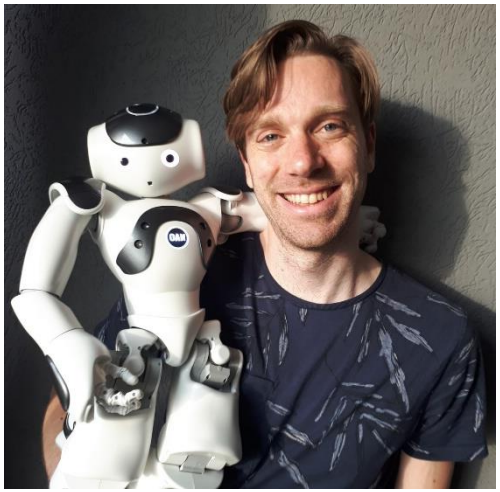
2016: Researcher & Lecturer — SAXION UNIVERSITY OF APPLIED SCIENCES

2022: PhD in Child-Robot Interaction — TU Delft, VU UNIVERSITY AMSTERDAM

2021: Post-doc (Long-term Child-robot interaction) — VU UNIVERSITY AMSTERDAM

Research Interests

- Shaping the child-robot relationship
- Interactive storytelling
- Long-term personalisation
- Robots in education
- Robots & performative narratives



Introducing the Teachers

Buelent Uendes

2017: Bachelor Business & Economics

2020: Master Economics & Econometrics

2021: Master Data Science

2021: Junior Lecturer in AI

Research Interests

- Machine Learning & Health
- Economics of Education/Well-being
- Social AI
- Deep Learning

Introducing the Teaching Assistants

Buelent Uendes (also TA & coordinator)

Georgiana Juglan

Freddy De Lima

Francesco Mattera

Oromia Sero

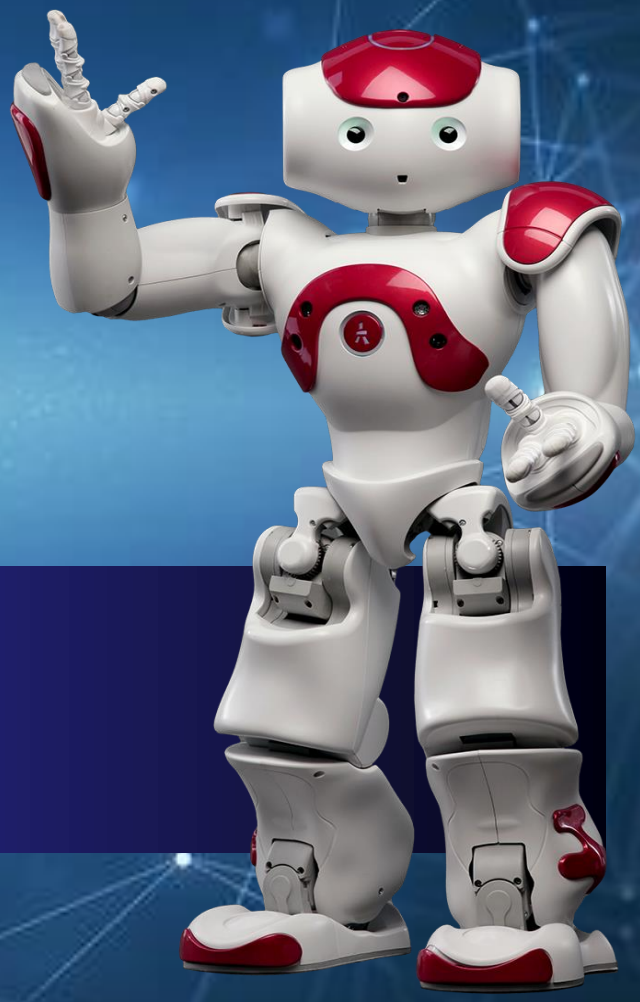
Kelly Spaans

Each group of 6 has its own TA.

Rules of engagement:

- For all your questions, contact your TA
- Your TA will contact us if needed

COURSE ASSIGNMENT



Course Objective

you will be designing a socially interactive robot prototype on a NAO humanoid robot for an interaction problem of your choosing

The main goals of this course are to enable you to:

- **create an interaction design** for a social robot
- **develop social robot capabilities** by applying AI techniques

Detailed info on Confluence wiki page

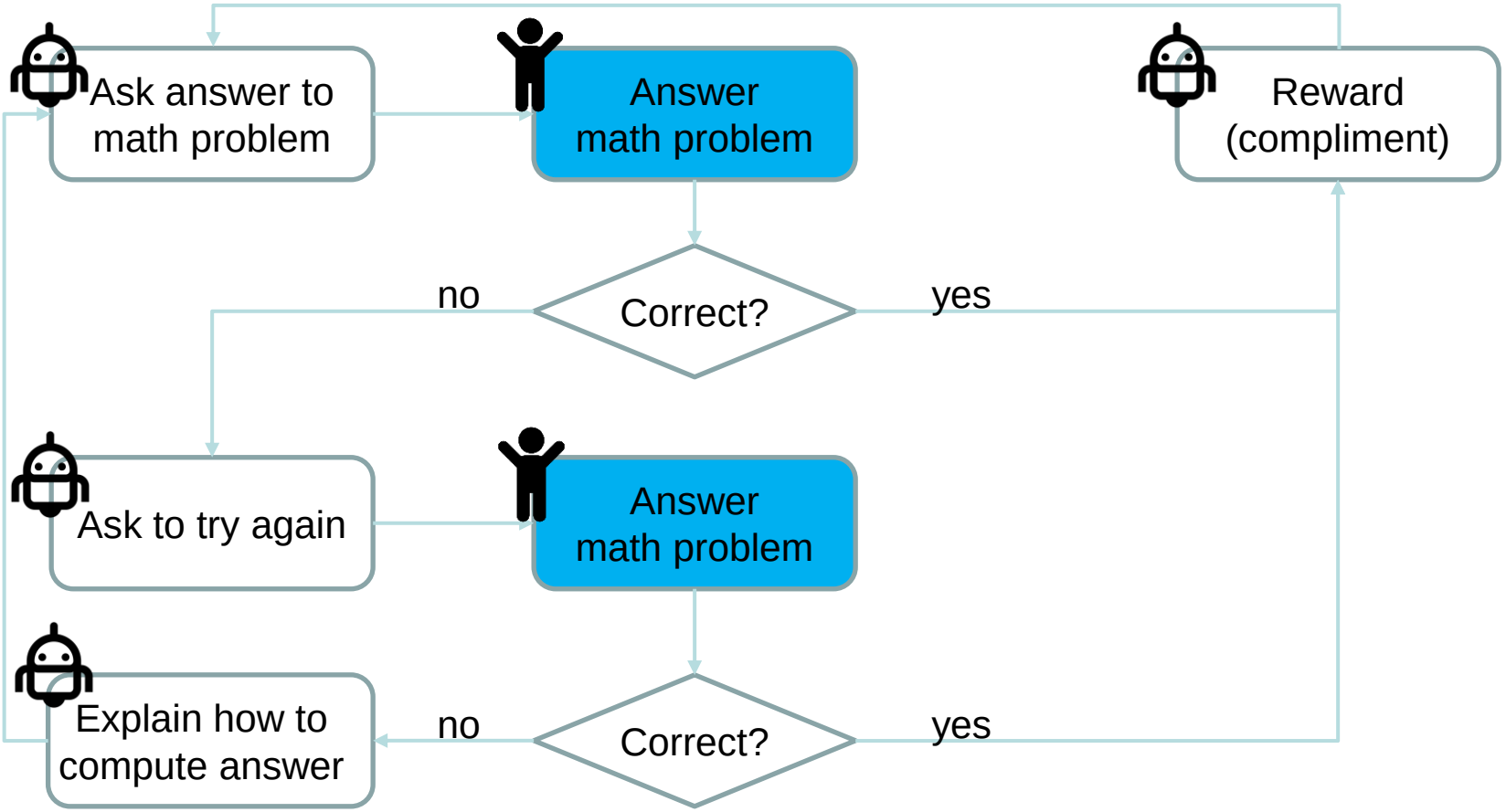
Looking for interaction design patterns

By creating and refining interaction design patterns we will help to move the human-robot interaction community forward.

- We are looking for solutions to interaction problems that are interaction design patterns:
  - identify **problems** in human-robot interaction,
  - provide solutions **based on basic principles of social behaviour and characteristics of human users**, and
  - provide **re-usable solutions** (interaction design ideas / scripts / techniques)

- No USE CASE but interaction problem
- You may design any type of (small) social interaction for your robot: e.g.,

Example interaction problem: Robot listening to children doing math

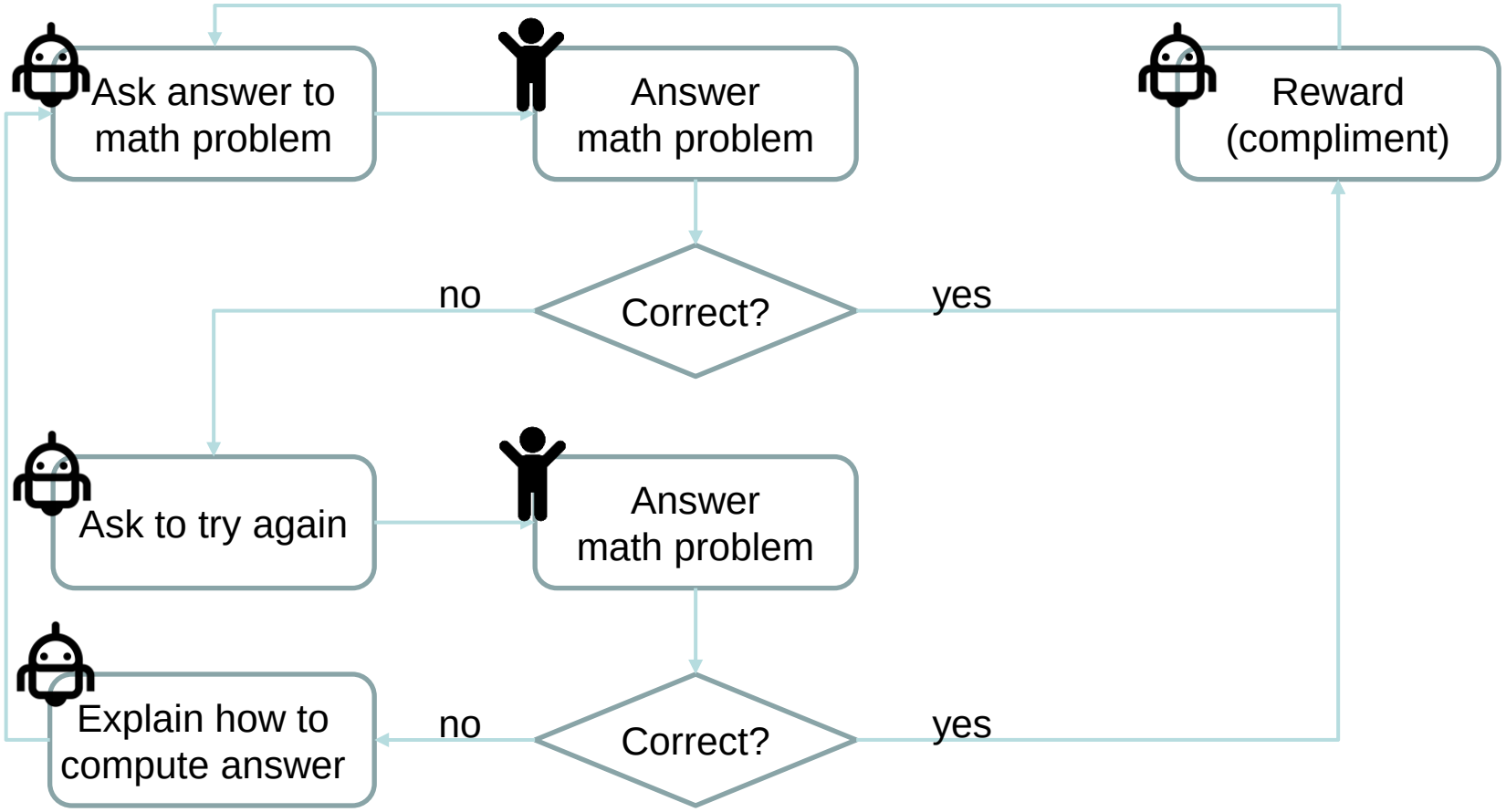


Problem: Children typically and naturally engage in thinking aloud behavior when trying to solve a math problem with a robot.

Interaction Design Pattern Example: Focus Speech Recognition on Answer

Problem	When asked to answer a question by a robot, children may engage in thinking aloud while trying to compute the answer to the question. Children's speech while thinking aloud is harder to recognise as speech volume, for example, is varied more. Both the longer and more complicated speech produced (instead of providing only the answer) and the variation in speech parameters complicates the natural language understanding, in particular the identification of the answer.
Principle	We do not want to restrict children in the way they compute an answer, and allow them to engage in thinking aloud and other interaction (e.g. asking another child sitting next to them). Instead, to provide an answer, a child is asked to indicate it is ready and focused to provide an answer.
Solution	A child is asked to indicate that it thinks it knows the answer to a question by means of a touch sensor. Touching the sensor will activate speech recognition and the robot will then listen for an answer for a specified period of time.

Example problem: Any other ideas?



Interaction problem: some observations

- Focus not on use case but on **interaction**: inspired by particular use case, but interaction problem and solution are more general and can easily be re-used for other use cases.

- In this example, various forms of **evaluation** can be done:
  - Did users like this form of interaction? Is user experience positive?
  - Were users effective in using it without any/much training? Did it come/feel natural?
  - …

- Often, a **problem hard to detect** is not visible from a simple interaction design flow:
  - Children had to write down math problem to be able to remember it while trying to solve it (cannot rely on memory!)

Design & develop robot prototype

You are completely free to choose your own interaction problem for your group project;

We do ask you to make sure you are:

- **creative** (think outside the box)
- extremely **specific** (topic narrow in scope & *realistic!*)

Should be some form of (social) interaction!

- The problem you address will only **be a (perhaps only small) part** of the interaction.
- You should **demonstrate your solution** to the problem in a small but clear interaction script or scenario.
- Embed your interaction solution in a **social activity**, e.g.:
  - Chit-chat with a robot
  - Playing a game with robot
  - Sharing memories (stories) with dementia patients
  - Gaze tracking for joint attention
  - ...
- *PS:* Does not need to (but of course can) use verbal dialog

Learning Objectives: Able to …

1. Explain what social robot interaction design is and specify an interaction problem for a robot
2. Identify, analyze, and apply relevant human-factors knowledge to a social robot design
3. Reflect upon evaluation approaches and create a procedure to evaluate a social robot
4. Apply basic principles to create a conversational design for a social robot
5. Explain what nonverbal communication and affect are and which parameters influence affect expression
6. Identify and explain basic techniques for making a robot socially aware
7. Analyse and evaluate basic ethical dilemmas related to social robotics interacting with humans
8. Perform a (pilot) user study to evaluate a social robot design

Course Schedule Overview

- Week 1-2: **first design ideas** and **problem specification**
- Week 3-4: **inspiration sources** from theatre students
- Week 4: first prototype ready
- Week 5-6: **finish implementation** (code)

  specify **evaluation procedure**
- Week 7: evaluate your robot with members 2 **other** groups
- Week 8: finish **design document**

  final **live presentation**

no exam

Multidisciplinary collaboration

Work together with UU theatre students who follow the *Expanding Performance* course

Each group matched to a few theatre students

- Session: interaction problem presentation (you)
- Session: moodboard (them)
- Final review of your demo video

Related to Acting like a robot project

Deliverables that will be graded

- **Robot software** (*20%*): work on this in *first six weeks* (not just in practical sessions!)

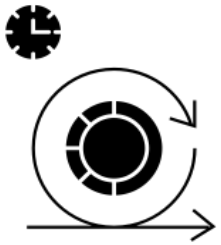
  Deadlines: first prototype Friday 25-11; final prototype Friday 9-12

- **Design document** (*50%*): extend & update every week, feedback from your TA each week

  Deadline: Monday 19-12

- **Final presentation** (*30%*) **Tuesday 20-12**: poster and video

  Deadline: Sunday 18-12



Also:

- micro-assignments (.5 penalty if you miss >1)
- top-2-ranked groups in each of two final presentation sessions (bonus of 1 point for first-ranked, .5 for second-ranked)

Software & Tools used

Confluence wiki for all details on the course:

Software:

- Social Interaction Cloud (**SIC**) infrastructure
- Google DialogFlow

Each group:

- **GitHub** classroom: **code** repository
- **Google folder**: design document, presentations, moodboard, video, poster

Use **Slack** for **communication** with group members, students, teacher, TAs

Working with a Nao Robot

Turning Nao on & off

Checkout the assignment page on confluence, week 1.

Working with a Nao Robot

Charging Nao

Working with a Nao Robot

Putting Nao into Rest Mode

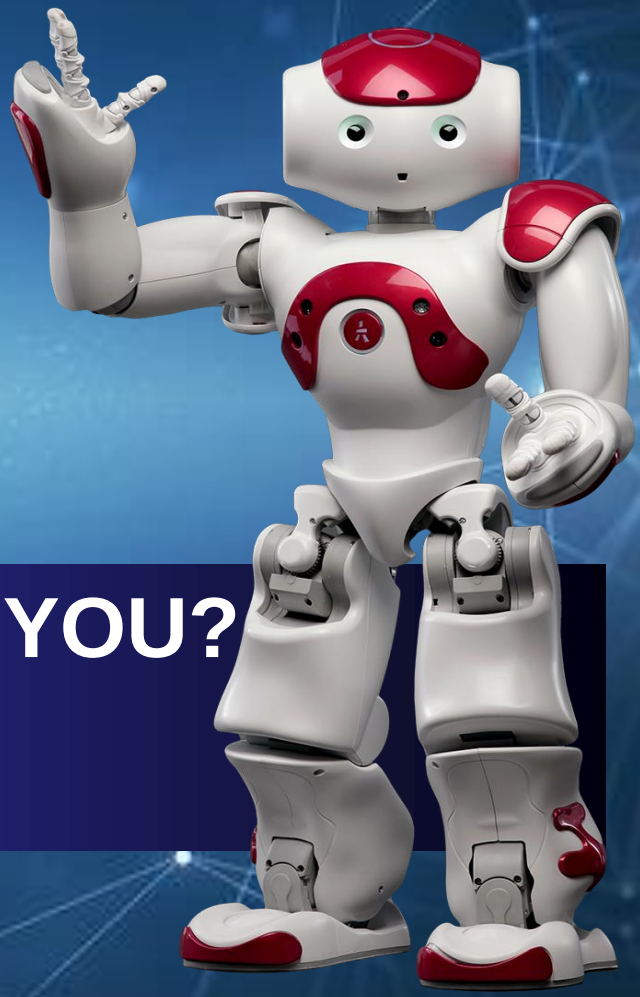
Documentation from Softbank: http://doc.aldebaran.com/

Working with a Nao Robot

Handling Nao

Documentation from Softbank: http://doc.aldebaran.com/

WHAT IS EXPECTED OF YOU?



Actively participate in Practical sessions

- Practical sessions @ VU:

  weekly meetings with your TA.

- Sessions:
  - peer review
  - meet UU theatre students

- Final demo presentation @ VU

Update agenda, schedule on confluence

Teamwork

- **Tight** *schedule*: heavy workload, access to robot only two slots a week: use practical session for coding and testing! continue coding without robot at home, plan & divide tasks & communicate(!!!) with group members

- **Competition**: Ranking of your final demo presentation by other groups

- *Check out assignment doc on confluence*

- **Have fun !**

Individual Contributions

We expect each of you to **contribute** to:

- Design document (ideas, text writing, etc.)
- Code (ideas, code writing, testing, etc.)
- Presentation (presentations, video)
- Organization (e.g., planning, meetings, …)

How do we assess your individual contribution?

- Will be monitored by your TA
- Individual Logbook to be updated every week

May result in different grades within a group

Practical sessions @ VU: COVID

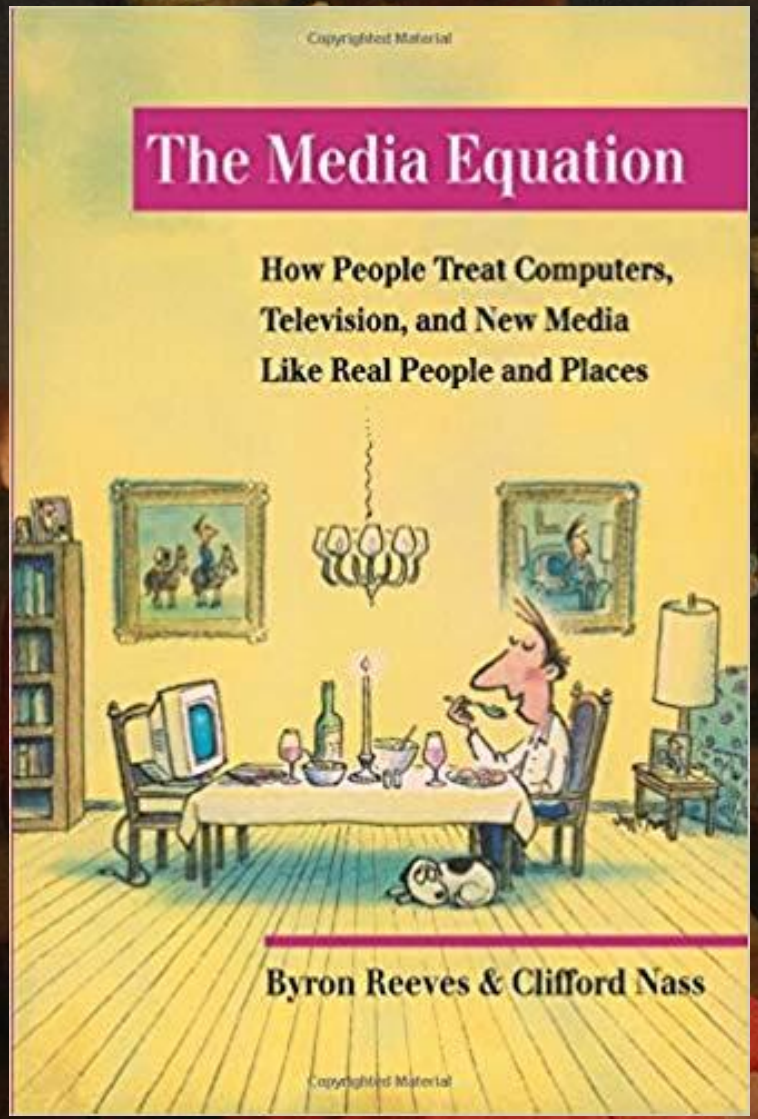
Latest information of the VU about COVID:
https://vu.nl/en/education/more-about/coronavirus-updates.

Current corona scenario: Dark green.

At VU Amsterdam, the following advice applies:

- Wash your hands often.
- Cough and sneeze into your elbow.
- Symptoms: coughing, sneezing, nasal cold, fever? Stay home and do a self-test. In case of a positive self-test, stay home for at least 5 days until you are symptom-free for 24 hours.

Treating Machines As Social Actors



AI-Driven Social Interfaces

Amazon Echo

Google Nest

Pepper

Nao

more social?

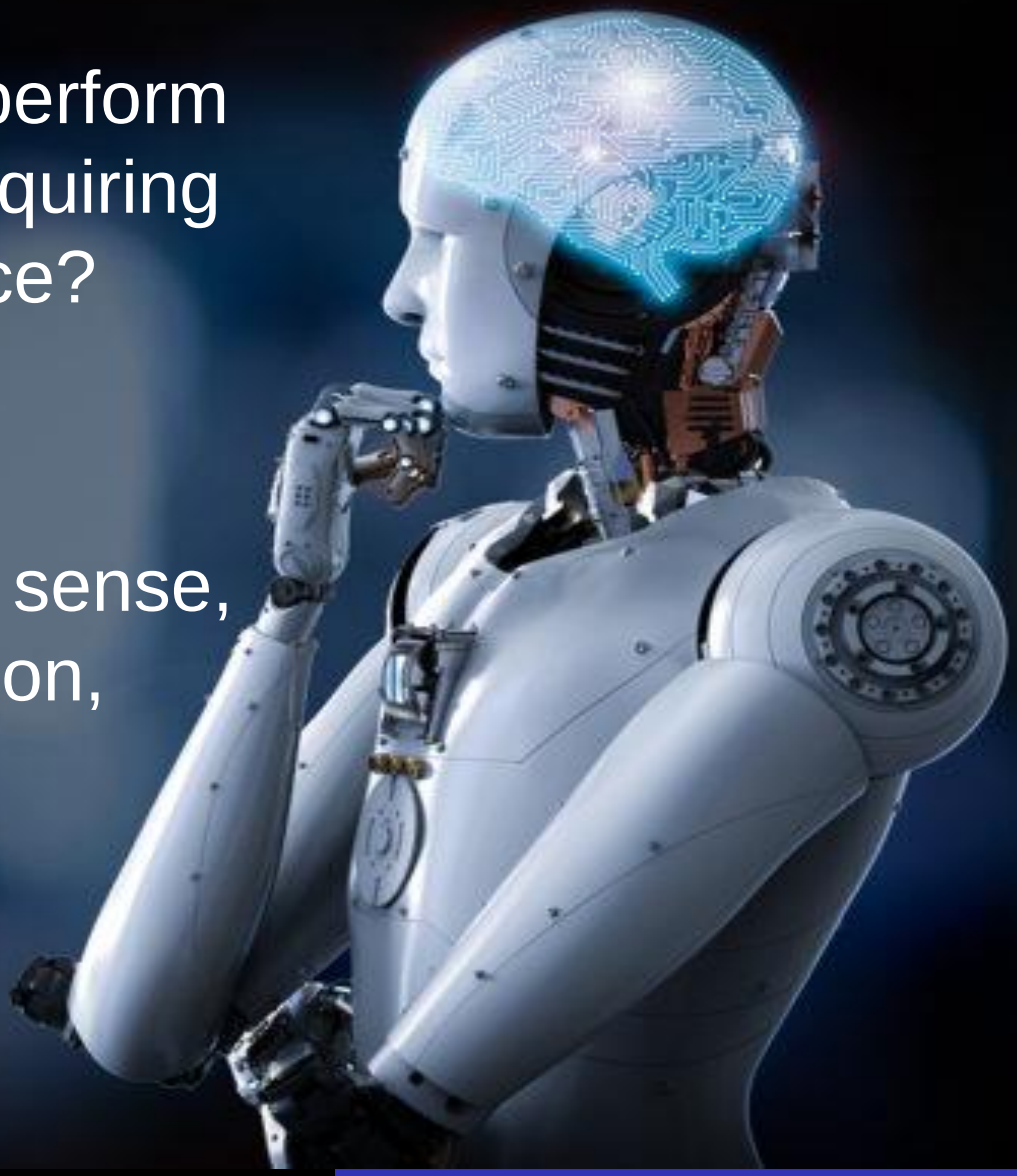
ARTIFICIAL SOCIAL INTELLIGENCE

Designing a Social Robot Brain

What is Artificial Intelligence?

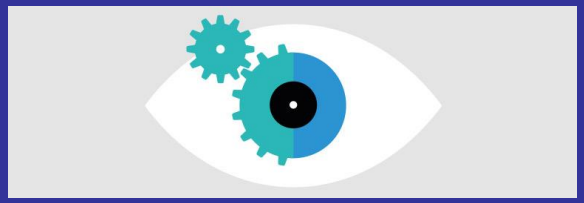
systems able to perform tasks normally requiring human intelligence?

systems that can sense, process information, and act!



Artificial Intelligence =

Computer Vision



Planning & Search

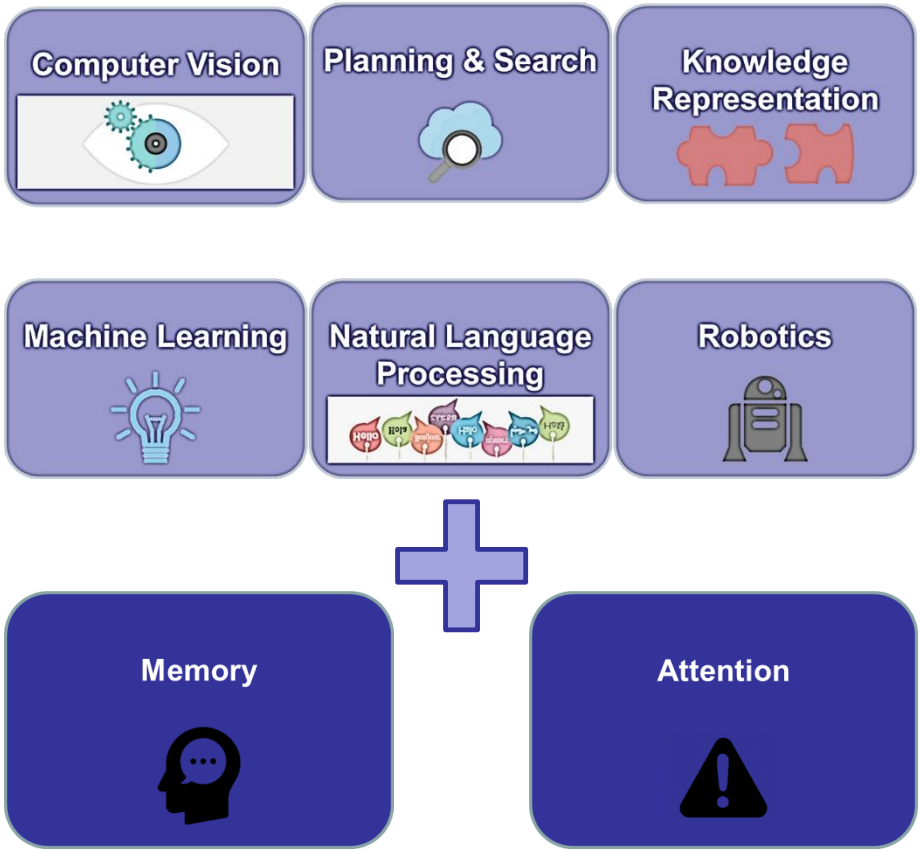
Knowledge Representation

Machine Learning

Natural Language Processing

Robotics

Social AI = Social Ψ + AI++



What is a Social Robot?

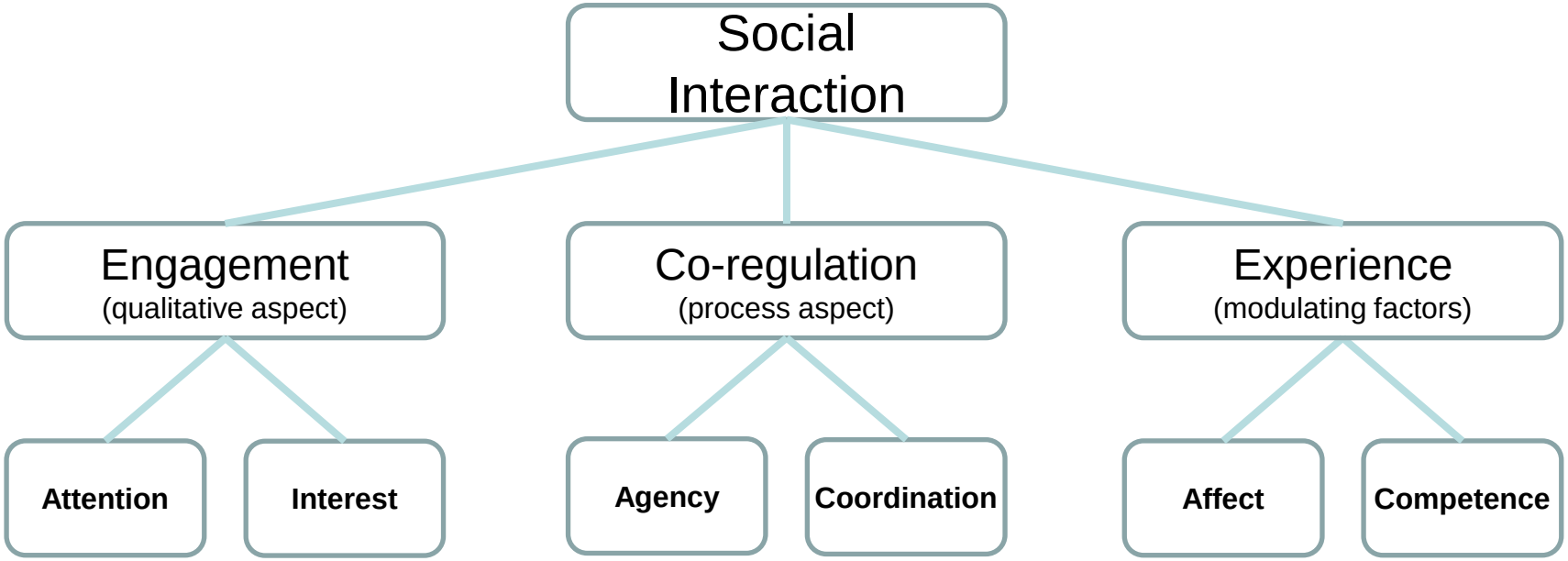
A social robot is a robot that is able to engage in social interaction with a human user

Should a social robot have these qualities?

1. Express and recognize emotions
2. Communicate verbally and non-verbally
3. Have a personality
4. Learn social skills
5. Get-to-know and recognize someone
6. Maintain social relationships
7. Be transparent
8. Be useful

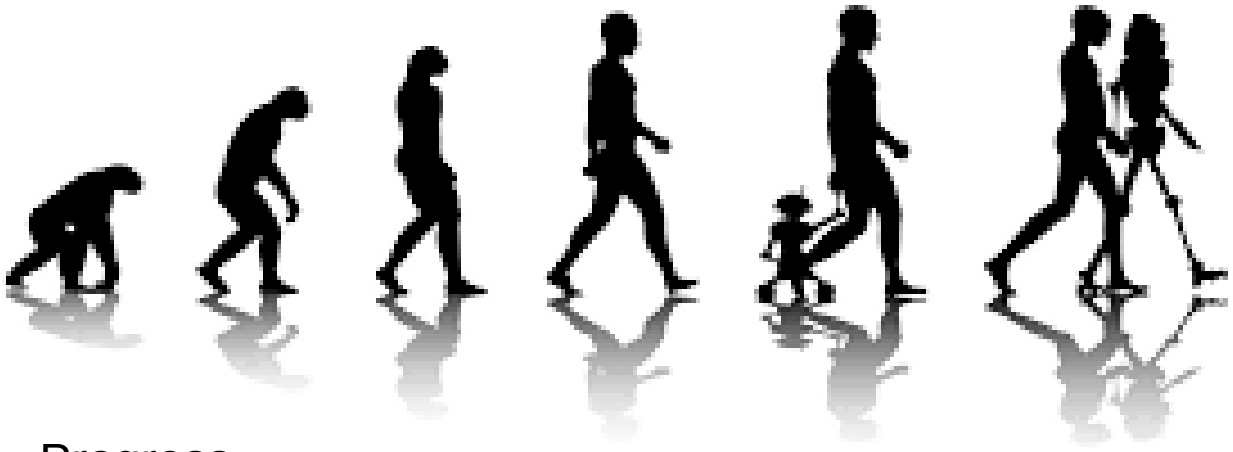
What is Social Interaction?

Minimal Theory of Social Interaction



What is Social AI?

How do we create a robot that is social?



Progress =

- more engaging:
  - maintain our attention more,
  - arouse our interests more, and
- more effective interaction.
  - increased coordination,
  - Increased feeling of agency

Learning to Speak the Language of Social Interaction

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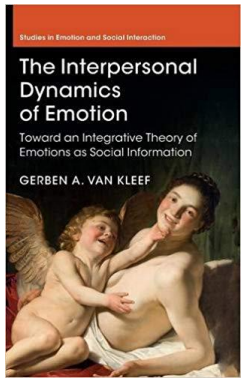
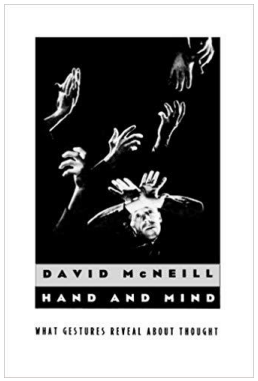
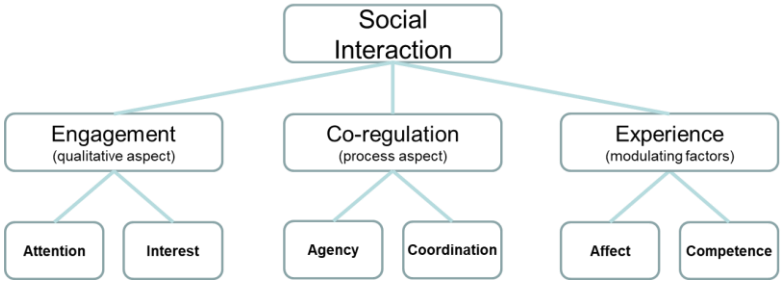




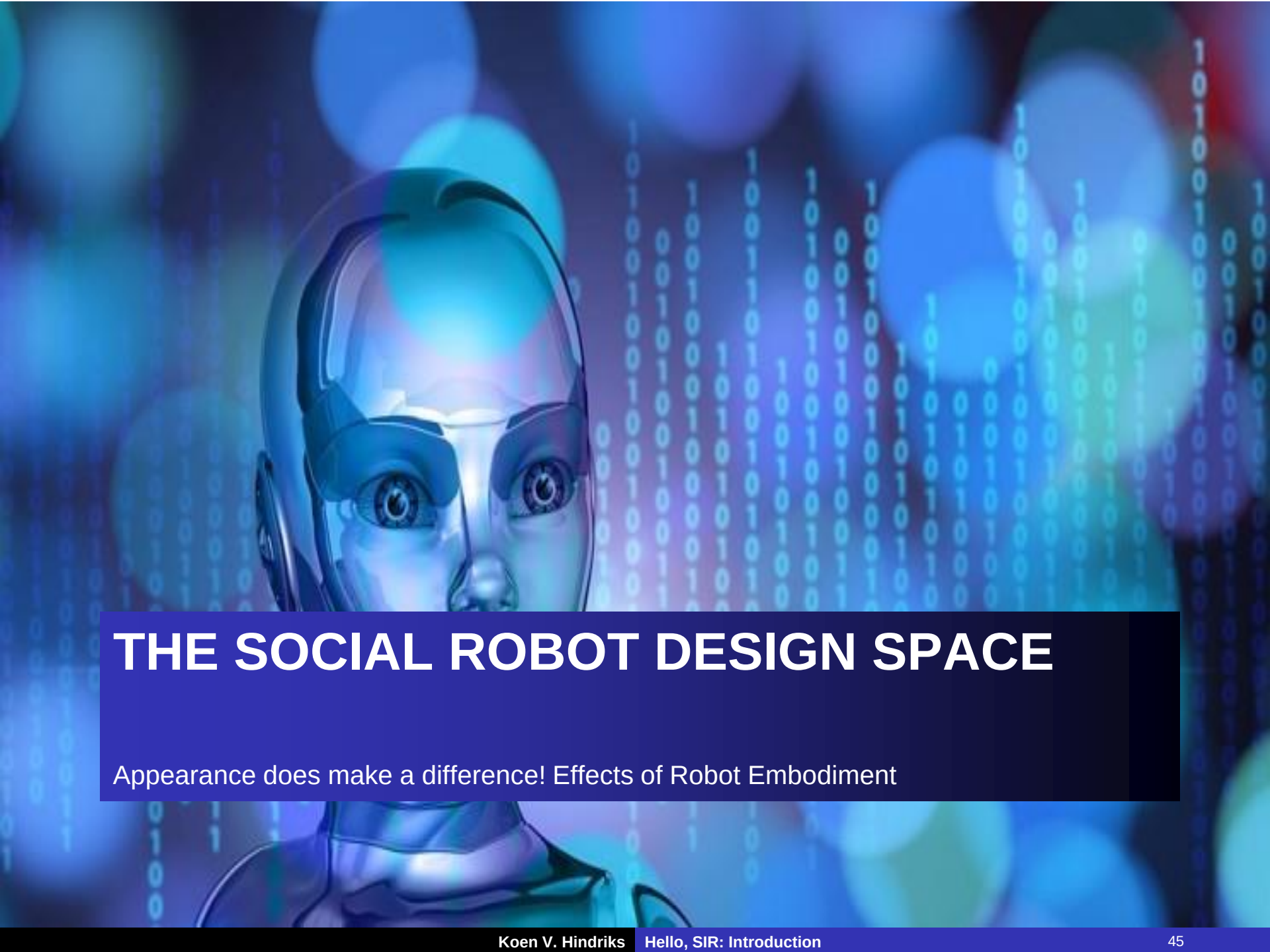
A two way street: Social awareness & presence

Robots that **socially interact** …



… need to demonstrate **social awareness**, i.e., perceive, interpret, and respond appropriately to verbal and nonverbal cues from humans …

… to be perceived as having **social presence**, i.e., the degree of connectedness with the other person in the interaction



THE SOCIAL ROBOT DESIGN SPACE

Appearance does make a difference! Effects of Robot Embodiment

Zoomorphic Robots that look like animals

AIBO robot dog

Leonardo robot

Mel penguin robot

Paro seal robot

Tega robot

Robots that (somewhat) look like humans

GRACE
2002

Maggie
2005

ARMAR III
2011

Furo
2015

UU (LK202)
2016

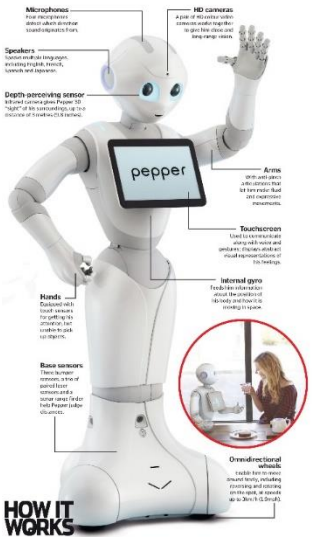
LG robot
2015

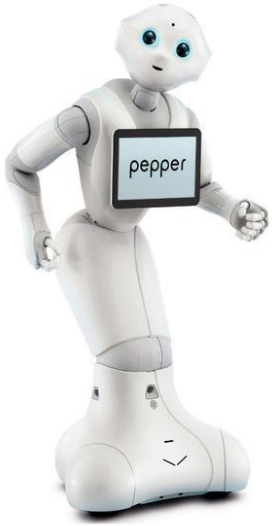
Mature Social Robot Platforms

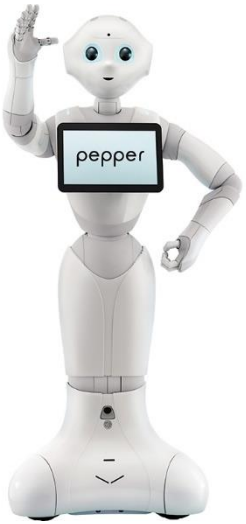
Robots with advanced capabilities.

‘Look & feel’ is right.

People like to interact with social robots.



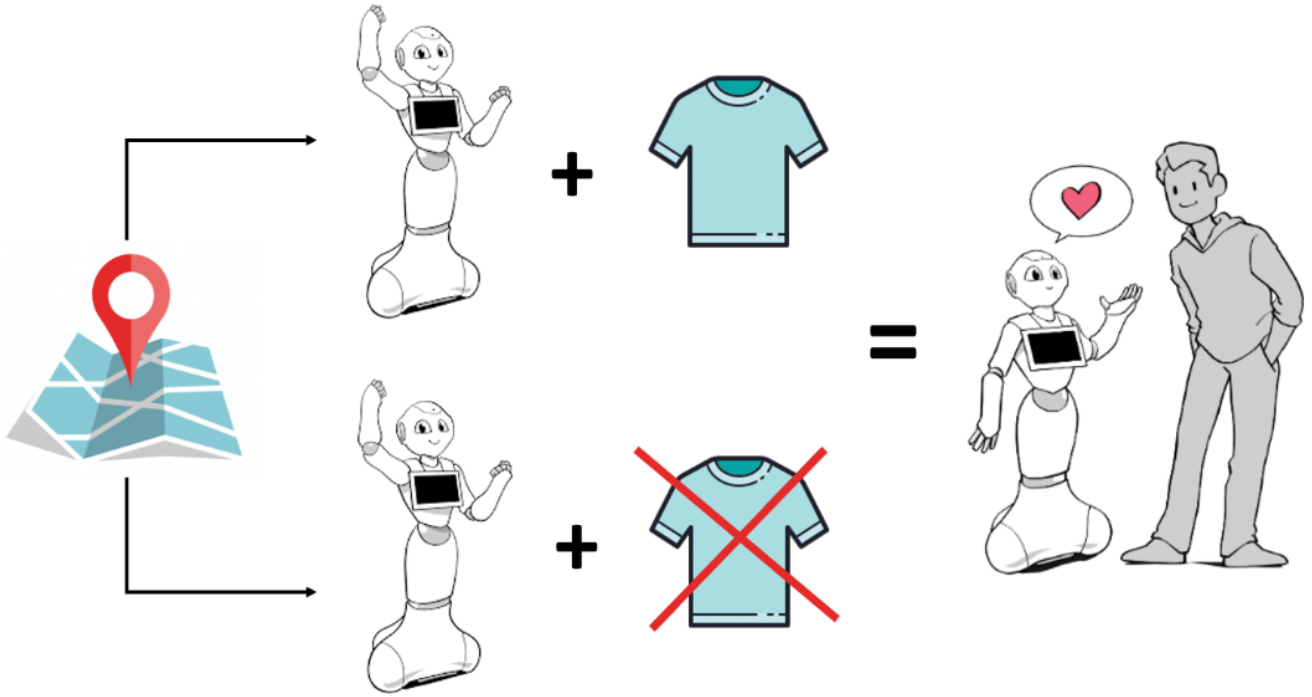




Appearances and Apparel

- Another form of Non-Verbal Communication
- Outfits impact people's first impressions
- You send messages and provides cues to people
- Creates assumptions and stereotypes

Interaction Problem: How does apparel affect users?

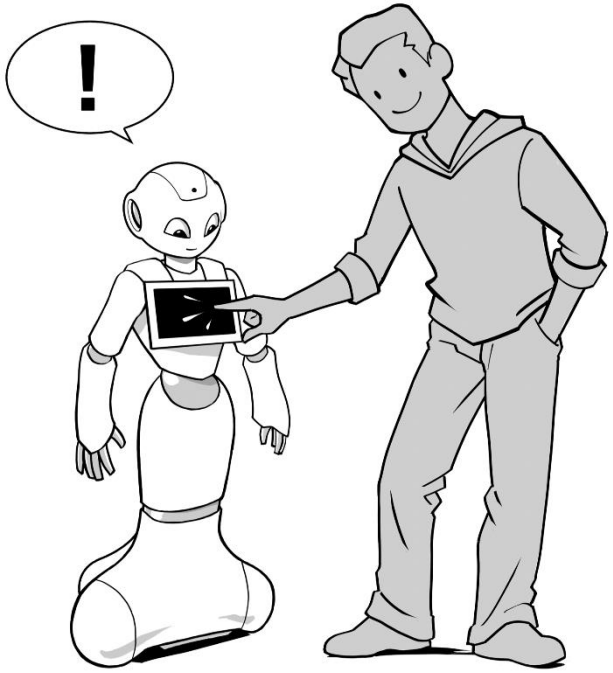


See:
Hindriks, K. V., Hagenaar, M., & Huckelba, A. L. (2022, August). Effects of Robot Clothing on First Impressions, Gender, Human-Likeness, and Suitability of a Robot for Occupations. In *2022 31st IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)* (pp. 428-435). IEEE.

Effects of Robot Clothing on First Impressions, Gender, Human-Likeness, and Suitability of a Robot for Occupations

Not only clothing design for robots but rather whether robot clothing may influence the…

For humans, clothing is a form of non-verbal communication which "functions as an effective means of communication during social interaction". This means that clothing can be used to encode messages for others to interpret and to form impressions about another.



- **First impression**
- **Perception** of **Gender & Human-likeness**
- Suitability for **particular role** or **occupation**

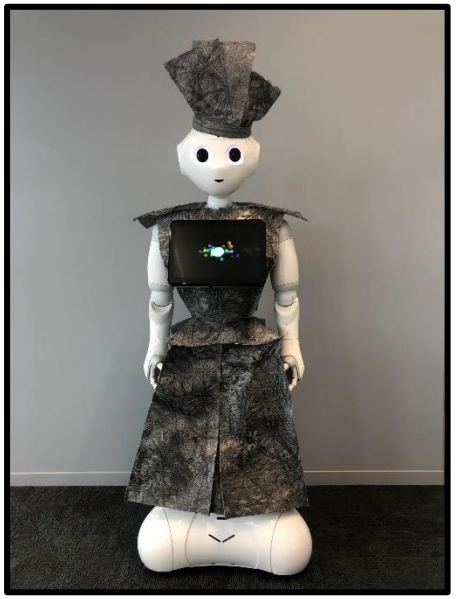
The Clothes

In discussions with the designer aspects related to gender, and role or occupation were taken into account.

NC

C1

C2



C3

Study Set-up

- Online Survey via Qualtrics hosted on MTurk
- 100 Participants (European. 60% Male, 40% Female)
- 4 Conditions: 3 with Clothing, 1 without
- Scales: First impressions, Gender, Human-likeness and Occupations

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- Depth interviews via Zoom with several experts in the robotics field:
  - "Health care expertise, Marketing expertise cultural sector, Fashion industry, Education, Hospitality and robots & theatre.
- Topics: Associations, Gender, Occupation, First impression, Opinion on clothing

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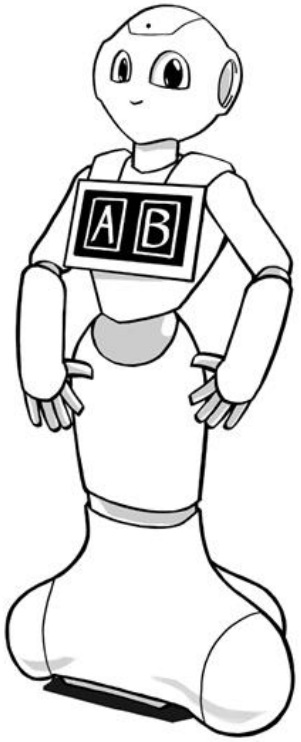
- Comparison non-clothed (NC) and clothed robot (C1)
  - 2240 participants (NC = 1338, C1 = 1102)
- Occupation: Reception tasks
  - Fully autonomously and was able to provide directions
- Location: University campus

Survey

TABLE I: Average Scores on scales for First Impression, Gender, Anthropomorphism, and on items for Occupations

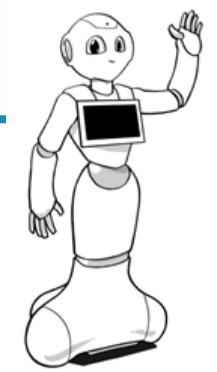
Construct	Total		No Clothing (NC)		Clothing C1		Clothing C2		Clothing C3		ANOVA		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	$F(3,96)$	*p*	η^2
Expertise	4.59	1.33	5.30	1.12	4.49	1.38	4.76	1.07	3.79	1.36	6.19	.001	0.16
Trustworthiness	5.05	1.09	5.36	1.12	4.76	0.89	5.41	1.02	4.65	1.17	3.58	.02	0.10
Social Dominance	3.54	1.19	3.66	1.07	3.42	1.42	3.73	1.13	3.34	1.13	0.61	.61	0.02
Likeability	4.58	1.08	4.93	0.91	4.13	1.10	4.84	0.85	4.40	1.30	3.19	.03	0.09
Friendliness	5.26	1.03	5.46	1.04	5.08	1.02	5.41	0.76	5.06	1.26	1.06	.37	0.03
Gender	3.52	2.00	3.71	1.88	2.32	1.03	3.56	2.12	4.54	2.21	5.92	.001	0.16
Name (coded; *[0-1]*)	0.34	0.44	0.40	0.44	0.06	0.17	0.32	0.46	0.58	0.48	6.92	.000	0.18
Human-likeness	2.64	1.59	3.00	1.45	2.44	1.29	2.89	1.63	2.21	1.91	1.36	.26	0.04
Anthropomorphism 1	3.28	1.28	3.29	1.32	3.08	1.22	3.37	1.27	3.35	1.35	0.27	.85	0.01
Anthropomorphism 2 *[0-5]*	2.41	1.17	2.29	1.30	2.36	1.19	2.41	1.05	2.58	1.21	0.27	.85	0.01
Home Health Aide	**3.56**	1.08	**3.54**	1.18	3.36	1.22	**3.81**	0.88	**3.50**	1.02	0.82	.49	0.03
Security Guard	3.00	1.29	3.42	1.06	2.80	1.38	3.00	1.18	2.83	1.49	1.17	.33	0.04
Teacher	3.28	1.26	3.33	1.44	3.24	1.33	3.41	1.22	3.13	1.12	0.23	.88	0.01
News Anchor	3.17	1.22	3.42	1.44	2.96	1.24	3.37	1.01	2.92	1.14	1.18	.32	0.04
Receptionist	**4.06**	0.95	**4.13**	1.12	**4.16**	0.99	**4.19**	0.83	**3.75**	0.85	1.14	.34	0.03
Household tasks	**3.52**	1.21	3.42	1.25	3.20	1.26	**3.56**	1.01	**3.92**	1.28	1.53	.21	0.05
Package deliverer	3.21	1.33	3.08	1.28	2.92	1.41	3.41	1.28	3.42	1.35	0.86	.47	0.03
Therapist	2.28	1.20	2.75	1.29	2.28	1.31	2.07	0.96	2.04	1.16	1.86	.14	0.06
Personal Trainer	2.83	1.24	3.13	1.26	2.76	1.33	2.67	1.07	2.79	1.32	0.64	.59	0.02
Tour-guide	**3.67**	1.11	**3.67**	1.20	**3.60**	1.08	**3.96**	0.85	3.42	1.28	1.08	.36	0.03
Personal Assistant	**3.56**	1.18	**3.88**	1.08	3.44	1.12	**3.93**	0.87	2.96	1.40	3.96	.01	0.11
Restaurant Server	**3.59**	1.16	**3.71**	1.16	3.16	1.18	**3.85**	0.91	**3.63**	1.35	1.72	.17	0.05
Sales Agent	2.63	1.22	2.83	1.27	2.28	1.17	2.78	1.25	2.63	1.17	1.04	.38	0.03

All occupation items were rated on a 5-point Likert-scale while all other scale items were rated on a 7-point Likert scale except where ranges [...] are explicitly indicated. Occupation ratings in bold score relatively high exceeding or being equal to the cut-off point 3.50 that we used.



Interviews

" It is in particular that cap that makes it a bit too much. It is of course a bit of the flight attendants think. Yes, those who belong to a certain society, say they all have a certain **uniform**. I think it has a kind of uniform idea."



"The second outfit (Green) makes the robot look **more human**. The shapes are not accentuated, and less robot is visible. This really appeals to me. "

" The **hips** make it **feminine**; I've seen the robot with a skirt on. If you look at the top you see broad **shoulders** and then you might think it is a **man**. "

" You have to think **carefully** about the clothes and that you are aware of what clothes do. If you give it to a police officer uniforms, then it is also something that shows authority and then you put the robot in a different **position** in relation to someone. If you put the Robot on a clown suit then that is of course completely different. "

Experiment “in the wild”

Clothed robot is more engaging than robot without clothes (based on initiated interactions).

Uniforms may raise expectations by the user.

Interaction

9.7% of people walking into building initiated with non-clothed robot (90.3% ignore rate). Whereas 13/9% of people did interact with C1 condition (86.1% ignore rate).

Gender

More males than females interacted with robot in C1 condition than NC. No significant association between sex and clothing found.

Testing behavior

Tested behavior depended on clothing condition, significant more testing behavior for C1 (7%) compared to NC (4%).

Performance rating

Similar scores for both conditions. Above average rating for NC. Ratings were significantly higher when the robot give an adequate response to a question.

Discussion

Clothing shapes our perception of others, ranging from gender, age, status, occupation, and even personality.

Conclusions

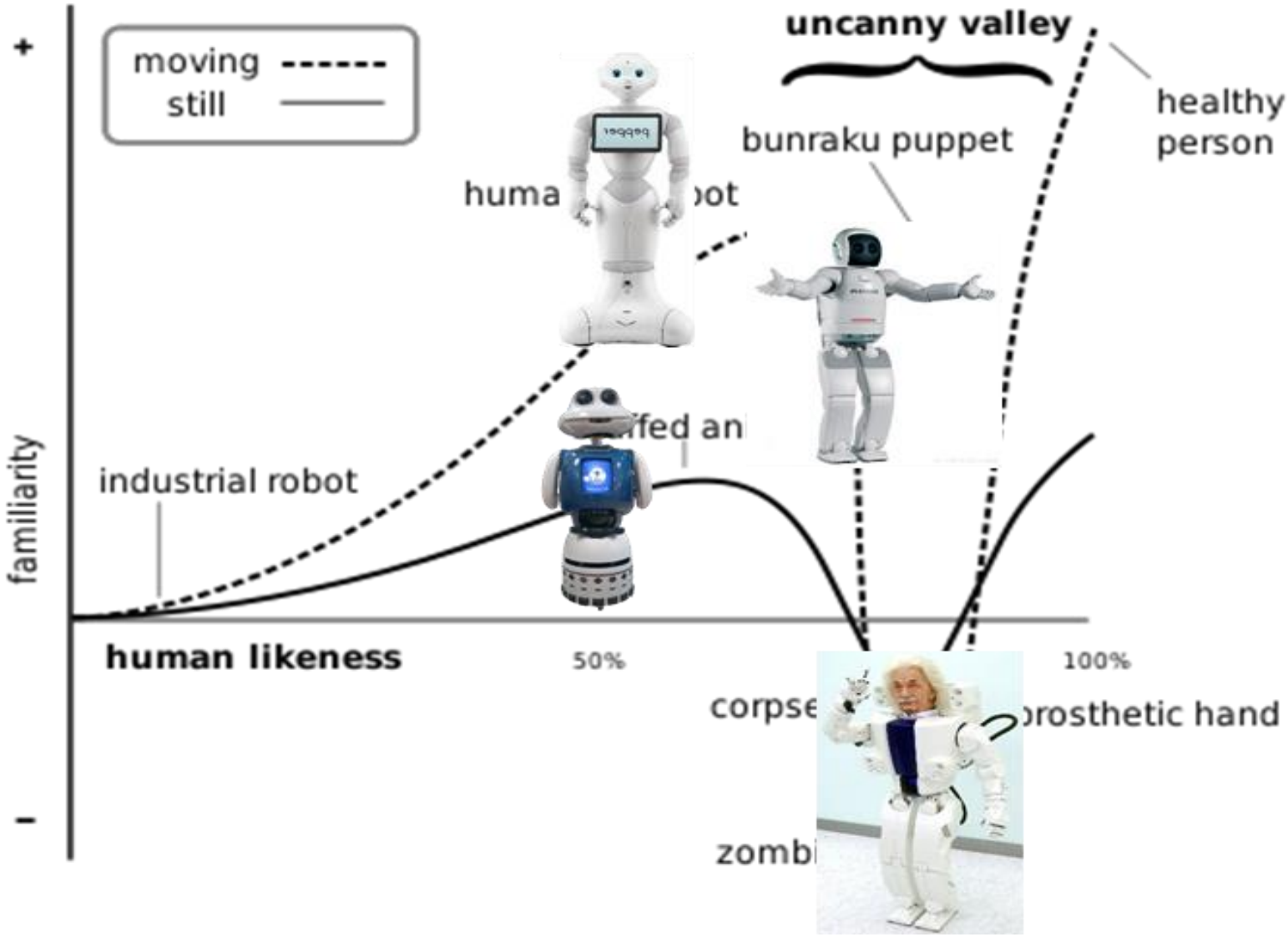
- Gender perception but not human-likeness can be manipulated by clothing.
- Robots with uniforms appear to be more appealing. Dress itself induce stereotypical job associations.
- First impressions on expertise and likeability may vary with dress.
- Robot's "identity" may be useful in practice. It could manage expectations and communicate its purpose

Future research

- Create specific outfits that match certain tasks or context.
- Explore the effect of different shapes and colours
- Explore the effects for clothes for different tasks and contexts
- Discuss sample and repeated measurements

Robot Clones (Ishiguro)

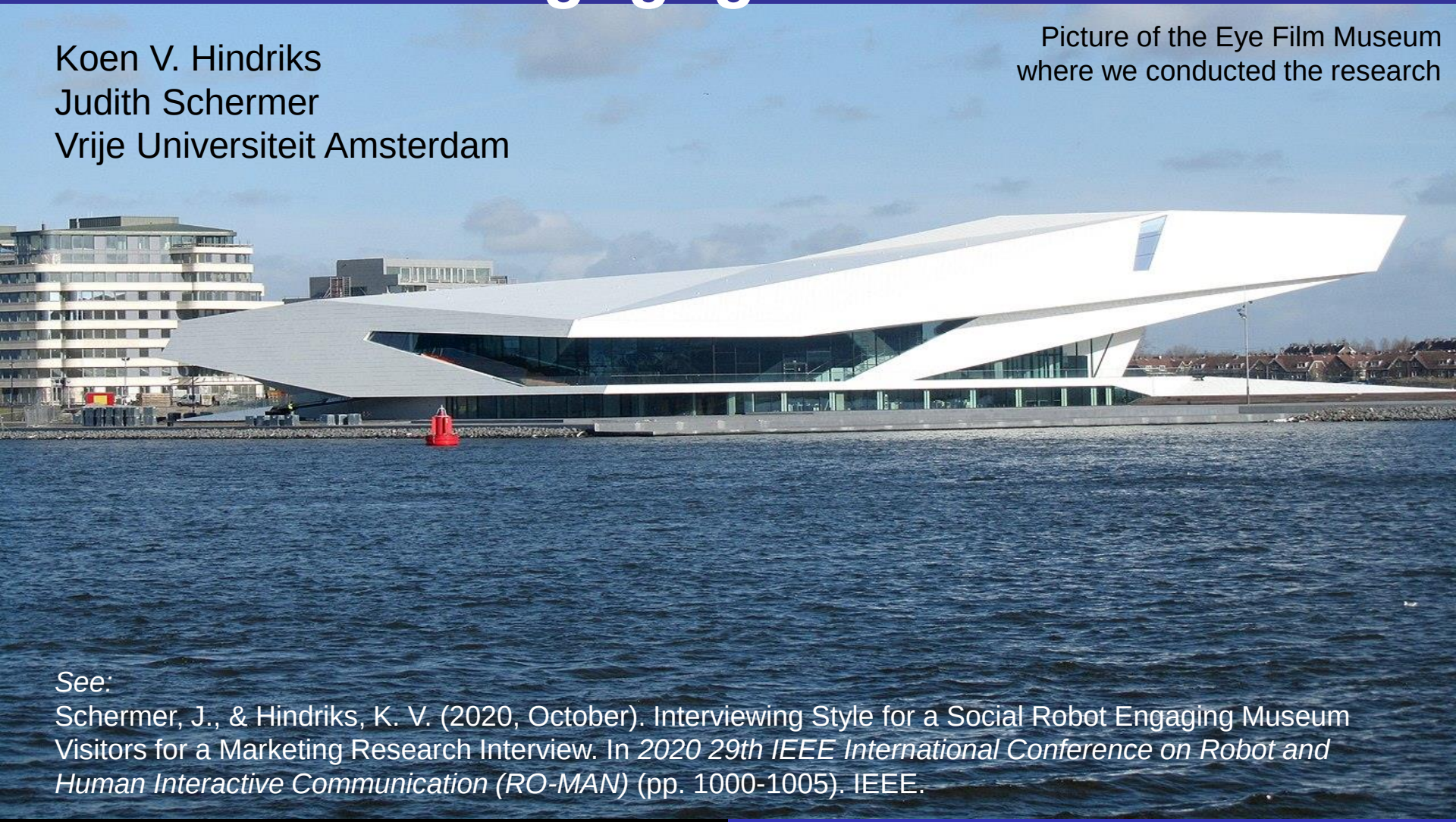
Uncanny Valley



SOME EXAMPLE INTERACTION PROBLEMS

Interaction Problem: How does Interviewing Style of a Social Robot Influence Engagegement of Visitors

Koen V. Hindriks
Judith Schermer
Vrije Universiteit Amsterdam



Picture of the Eye Film Museum where we conducted the research

See:
Schermer, J., & Hindriks, K. V. (2020, October). Interviewing Style for a Social Robot Engaging Museum Visitors for a Marketing Research Interview. In *2020 29th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)* (pp. 1000-1005). IEEE.

Goal:
Collect Visitor (User) Data for Marketing

- Currently, only visitor counts are automatically maintained by the Eye Film Museum

- Goal is to automatically collect visitor data, e.g.:
  - Is this the first time that you visit Eye?
  - Where do you live?
  - Would you recommend Eye to a friend?
  - Did you come for this exhibition specifically?
  - What is your age?
  - On a scale of 1-10, what rating would you give Eye?

- Question: How can a social robot best do this?

Take Home Messages

1. Social robot can be effectively used to collect visitor data.

2. Dropout rate is still high due to interaction challenges “in the wild”

Interviewing Style makes a Difference

A human personal interviewing style:

- motivates respondents to do well on task
- inclines respondents to ingratiate themselves with an interviewer

W. Dijkstra, “Interviewing style and respondent behavior: An experimental study of the survey-interview,” Sociological Methods & Research, vol. 16, no. 2, pp. 309–334, 1987.

Incentive to increase response

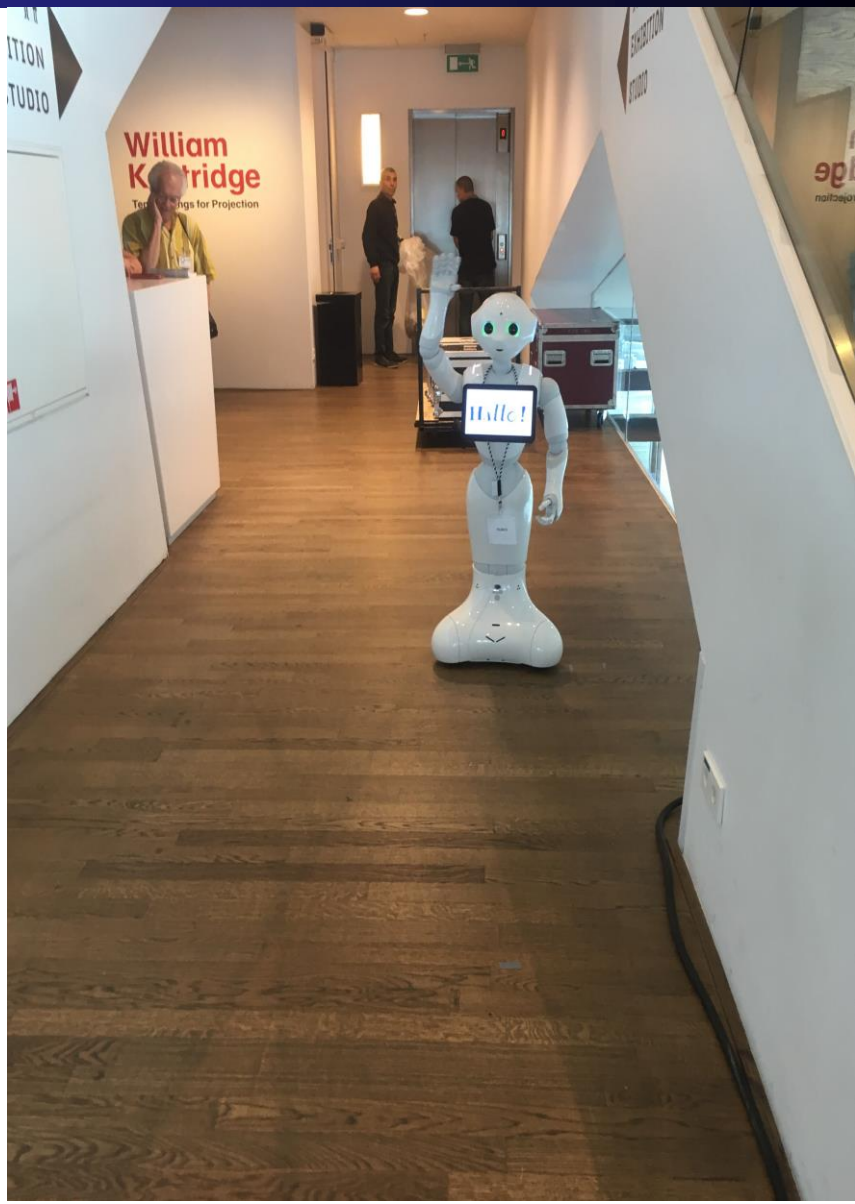
Human research found that promising an incentive produces a significant increase in response rates

E. Singer, J. Van Hoewyk, N. Gebler, and K. McGonagle, The effect of incentives on response rates in interviewer-mediated surveys, Journal of Official Statistics, vol. 15, no. 2, pp. 217, 1999

J. Yu and H. Cooper, A quantitative review of research design effects on response rates to questionnaires, Journal of Marketing research, vol. 20, no. 1, pp. 36–44, 1983.

Robot Design

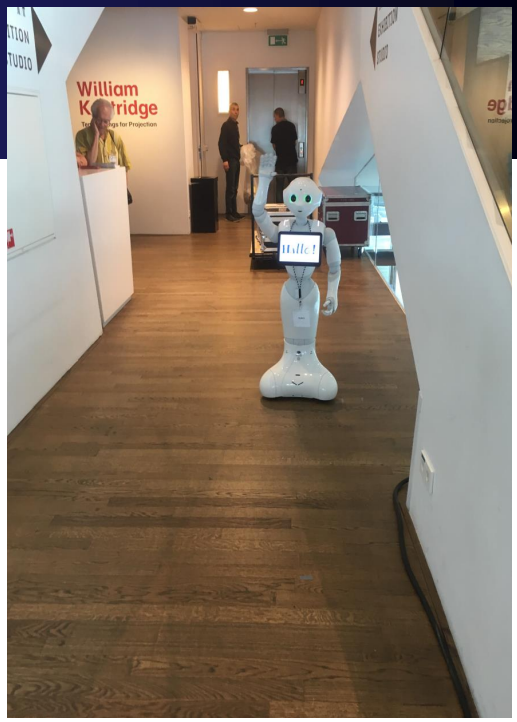
- robot *takes initiative* to engage passersby *by means of people detection*
- offers *picture* with itself *as incentive*
- personal style: warmer speech, bigger gestures, warm eye colors, and tablet display



Personal versus Formal Conversational Interaction Pattern

Problem	Survey interviews are structured Q&A pairs of questions asked by the interviewer and answers provided by the interviewee. In an interview, a robot may want to use a more personal versus a more formal interviewing style in how it interacts with survey participants.
Principle	We systematically want to adapt the verbal behaviour associated with each Q&A pair to make it more personal or formal and propose a fixed structure for both styles with the aim of reinforcing the effectiveness of the manipulation.
Solution	Each Q&A pair in a personal style is adapted according to the formula C-Q-A-P: the robot first provides a personal comment about itself (C), then asks the question (Q), waits for the answer (A), and praises or provides a complement to the interviewee (P). The formal style uses the formula: Q-A-Ack, with Ack being a formal acknowledgement. For example, in the personal style the robot first says *I am five years old.* (the age of Pepper since it first became available in 2014), asks the question *What is your age?*, and then praises the respondent, e.g., *74, what a beautiful age*. In the formal style, the robot immediately asks the question and only acknowledges the answer, e.g., generally by saying *okay*, *yes* or a repetition of the answer (*I heard 74*).

Evaluation



Method:

- *in the wild* sessions with museum visitors

Manipulation:

- *interviewing style* and *incentive offered or not*

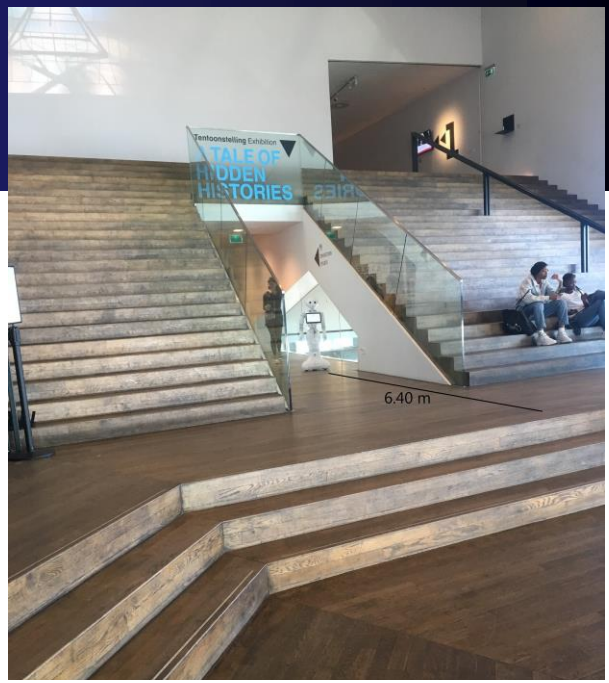
Measures:

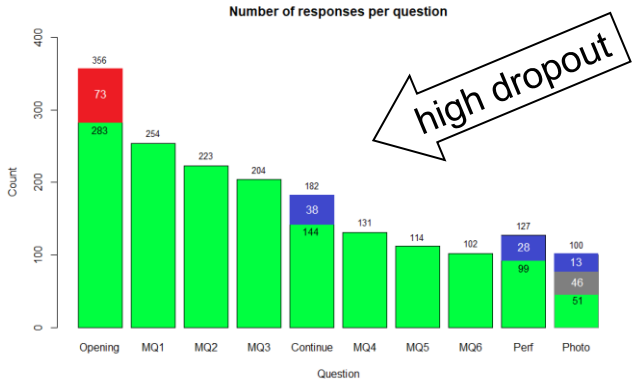
- measured *ignore rate* and *dropout rate*, and *museum rating*

Results

Social robots have a great potential for conducting intercept interviews:

- *willingness to participate is high (70-90%, compared to usual 55%)*
- *manipulation check*: personal style is perceived as more social
- participation rate is lower(!?) when robot provides incentive
- no effect of style on dropout rate
- no effect of style on museum ratings





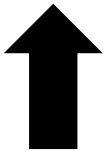
Interaction Design Purpose: Eliciting Self-Disclosure

INTERACTION PROBLEM: HOW CAN A CHILD AND A ROBOT GET ACQUAINTED?

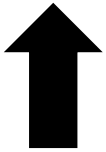
See: Ligthart, M., Fernhout, T., Neerincx, M. A., van Bindsbergen, K. L., Grootenhuis, M. A., & Hindriks, K. V. (2019, May). A child and a robot getting acquainted-interaction design for eliciting self-disclosure. In *Proceedings of the 18th international conference on autonomous agents and multiagent systems* (pp. 61-70).

Motivation

Long-term / repeated interaction



Relationship formation / bonding



Getting acquainted

Getting Acquainted Interaction

1. Child gets acquainted with robot
   a. The child learns how to communicate with the robot effectively
   b. Managing the expectations of the child
   c. The child gets *familiar* with the robot

2. Robot gets acquainted with child

3. Relationship formation / bonding is initiated

Human Factors: How do humans get acquainted?

Form of interaction:

- Unstructured dyadic interaction

Social norms aspect:

- Mutual self-disclosure
- Appropriate intimacy over time

Personality:

- extraversion matching

Focus: self-disclosure elicitation

[Unstructured conversation vs. autonomous CRI]

Structured Dyadic Interaction Design

[Social norms: reciprocation and intimacy]

Robot-disclosures

[Extraversion matching]

Behavior adaptation to extraversion trait child

Four Basic Interaction Design Patterns

1. Pairing closed-ended and open-ended questions:

   Do you like soccer or dance best? <X>

   Why do you like <X> best?

2. Pseudo-open-ended questions

   What is your favorite kind of animal? <X>

   Why is <X> your favorite kind of animal?

3. Positive back channeling

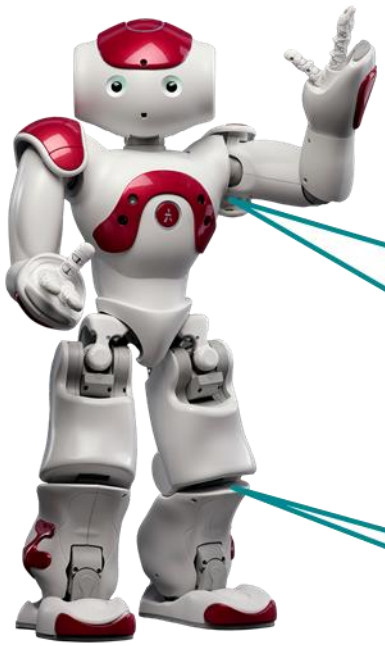
   E.g., “uhuh”; “That’s my favorite too!”; “Go on. Tell me more.”

4. Touch-based recognition and repair pipeline

Fifth Integrating Design Pattern: six-step turn-taking

1. Robot takes initiative and asks closed-ended / pseudo-open-ended question
2. Child answers
3. Robot responds to child's answer
   a. Backchannel and/or
   b. Robot disclosure
4. Robot asks open question
5. Child answers
6. Robot acknowledges answer

Example Interaction



What is your favorite pet?

A dog.

That is my favorite too! I like it when dogs waggles their tails when they are happy.

Why is a dog your favorite?

[Open answer]

Example Interaction

Interaction shaping: Extraversion adaption

Behavior setting	More energetic	Less energetic
Speech speed	100%	90%
Speech volume	49	40.5
Language style	Directive	interrogative
Emotion words	Strong	weak
Speech activity detection interval	2-3s (100%)	2.5 -3.75s (125%)
Gestures amplitude	100%	60%
Gesture speed	100%	50%
Head movement speed	100%	75%
Breathing animation	20 bpm	10 bpm
Activity order	Dance – game	Game - dance

Evaluation

1. How effective are the five interaction design patterns for maintaining an autonomous getting acquainted conversation?

2. What effect has the energeticness of the robot on self-disclosure for introverted and extraverted children respectively?

User study

- N = 75
- 8 – 11 y.o.
- 45 girl – 30 boys
- 4 classes from 2 Dutch primary schools
- Design:
  - 2x2 between-subject design
  - DV: amount and intimacy of self-disclosures
  - Balanced age, sex, and extraversion

Structured Dyadic Interaction Design Results

How successful are the different questions in eliciting self-disclosure?

	#	Response rate
Closed-ended	542	**98%**
Pseudo-open-ended	285	**99%**
Open-ended	533	**88%**

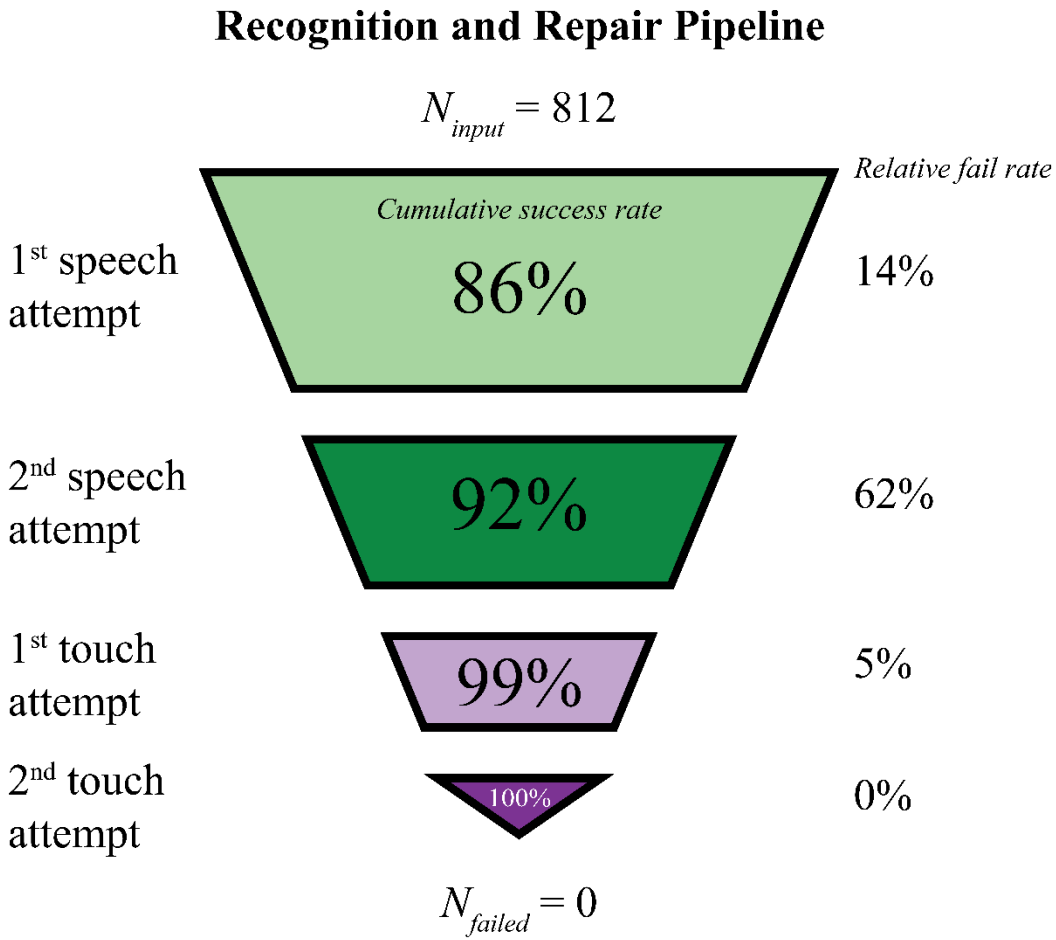
Structured Dyadic Interaction Design Results

Do children give valid (i.e. pre-specified) answers to the pseudo-open-ended (and closed-ended) questions?

Type	#	Response rate	Valid
Closed-ended	542	98%	**97%**
Pseudo-open-ended	285	99%	**95%**
Open-ended	533	88%	**n/a**

Structured Dyadic Interaction Design Results

How successful is the recognition and repair pipeline and is the touch-based mechanism an effective alternative?



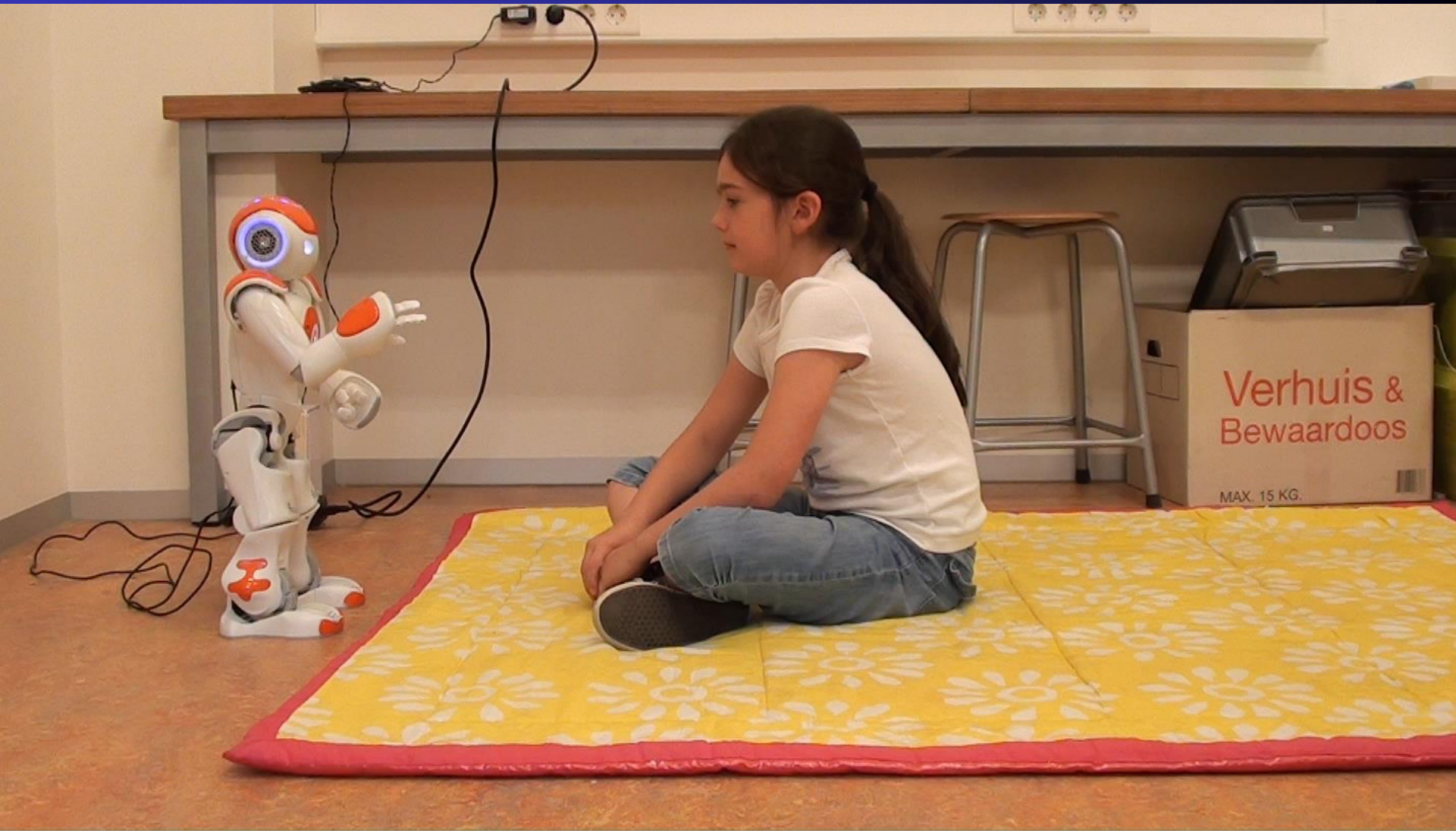
Structured Dyadic Interaction Design Results

How often is speech incorrectly recognized and how do children respond to those mistakes?

8.7%

Incorrectly recognized speech

Example interaction



Structured Dyadic Interaction Design Results

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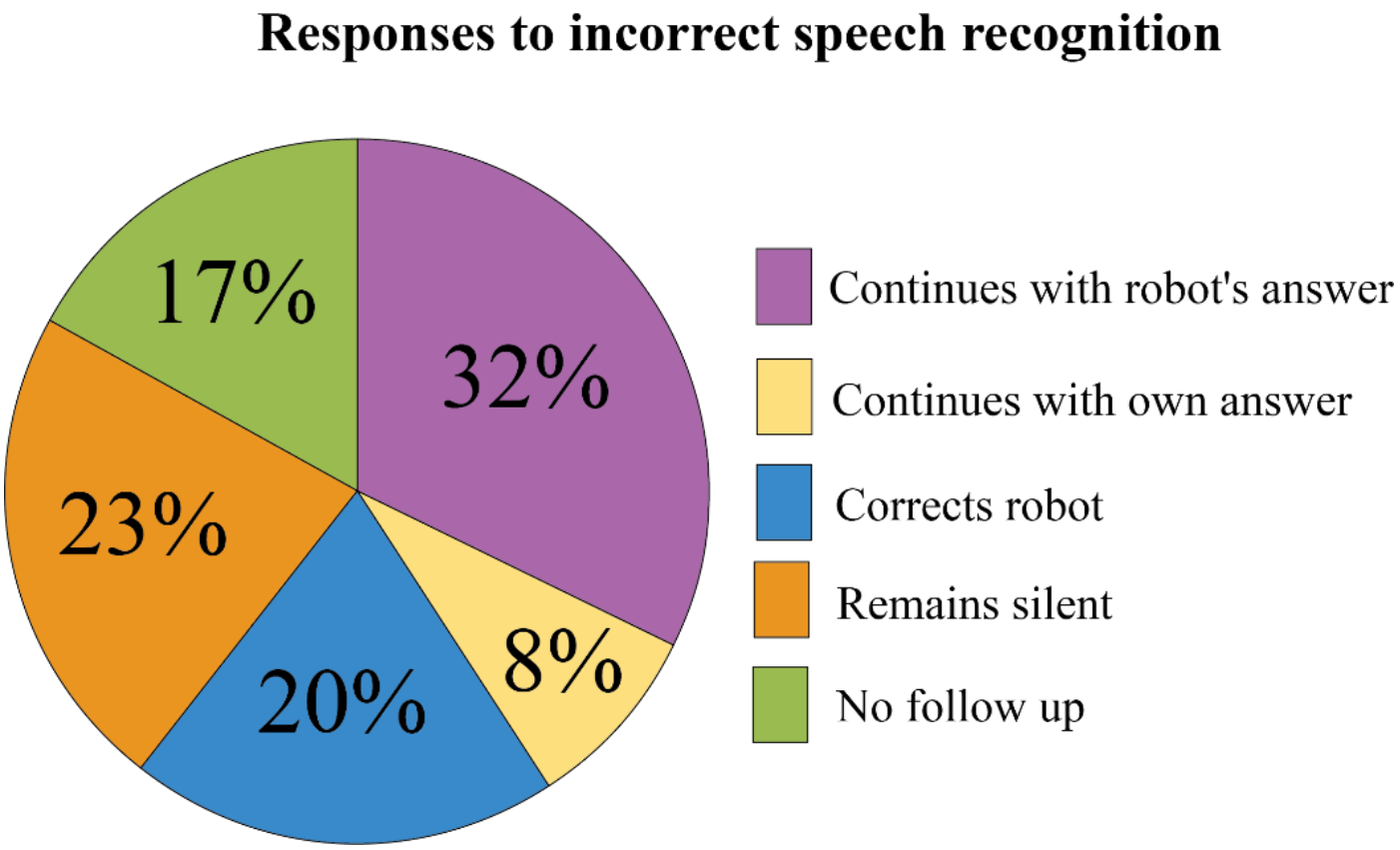
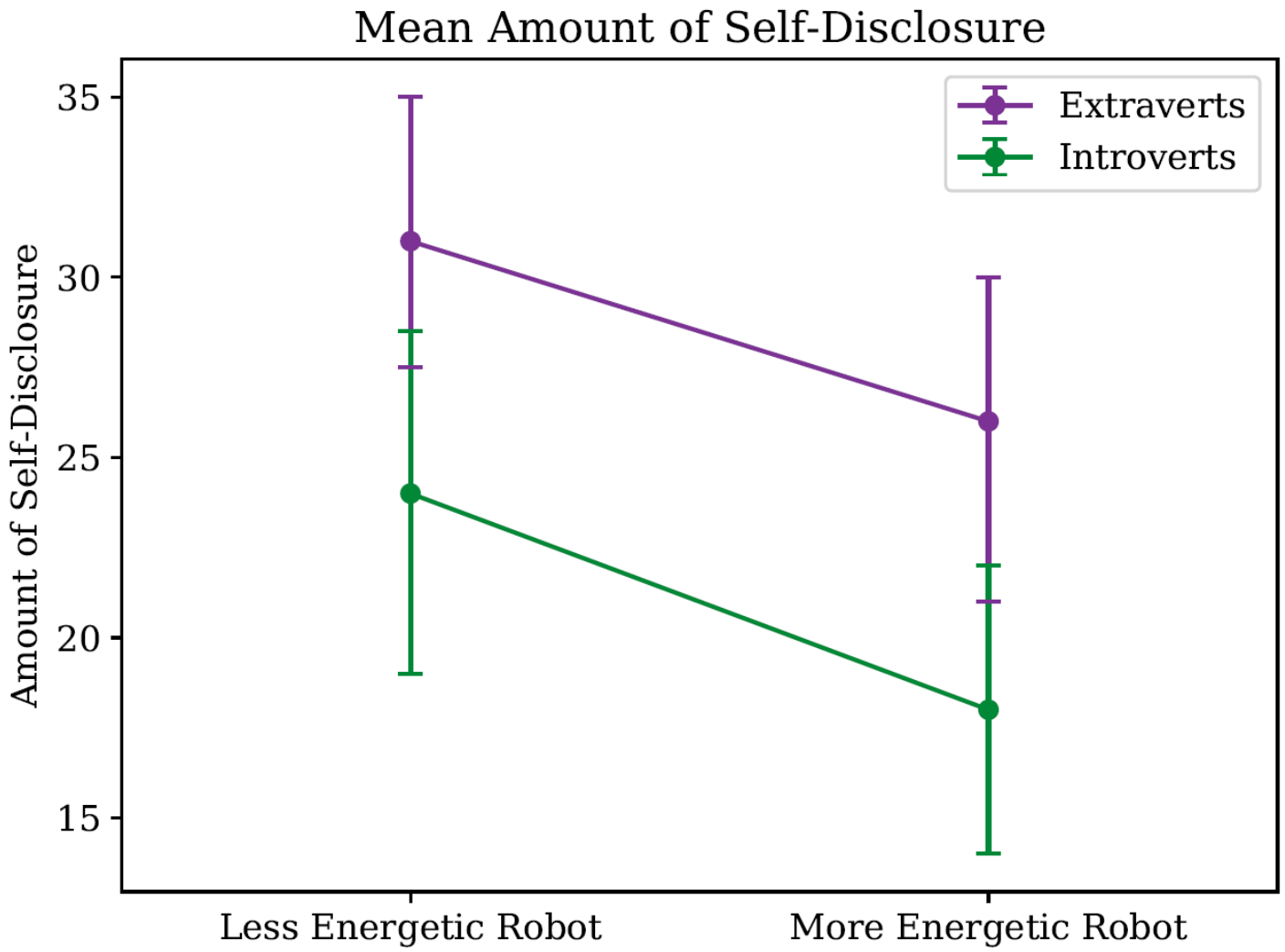


Energeticness, extraversion and self-disclosure



Discussion

- First steps towards an autonomous social robot that can repeatedly engage with children.

- Recommend focusing on lower-level behavior aspects of the interaction than high-level and convoluted psychological constructs.

Organizational Stuff

Homework:

- **Reading assignment**: See confluence course schedule! finish before lecture Wednesday
- **Watch tutorial videos** See confluence course assignment, week 1:
  - How to handle NAO! It's an expensive robot.
  - Social Interaction Cloud tutorial videos.

Coming Lectures:

- Next lecture coming Wednesday: micro-assignment, so be there! (part of your grade).
- This week also an (online) lecture introducing the Social Interaction Cloud (SIC) framework.