Hello, SIR
Introduction to Socially Intelligent Robotics

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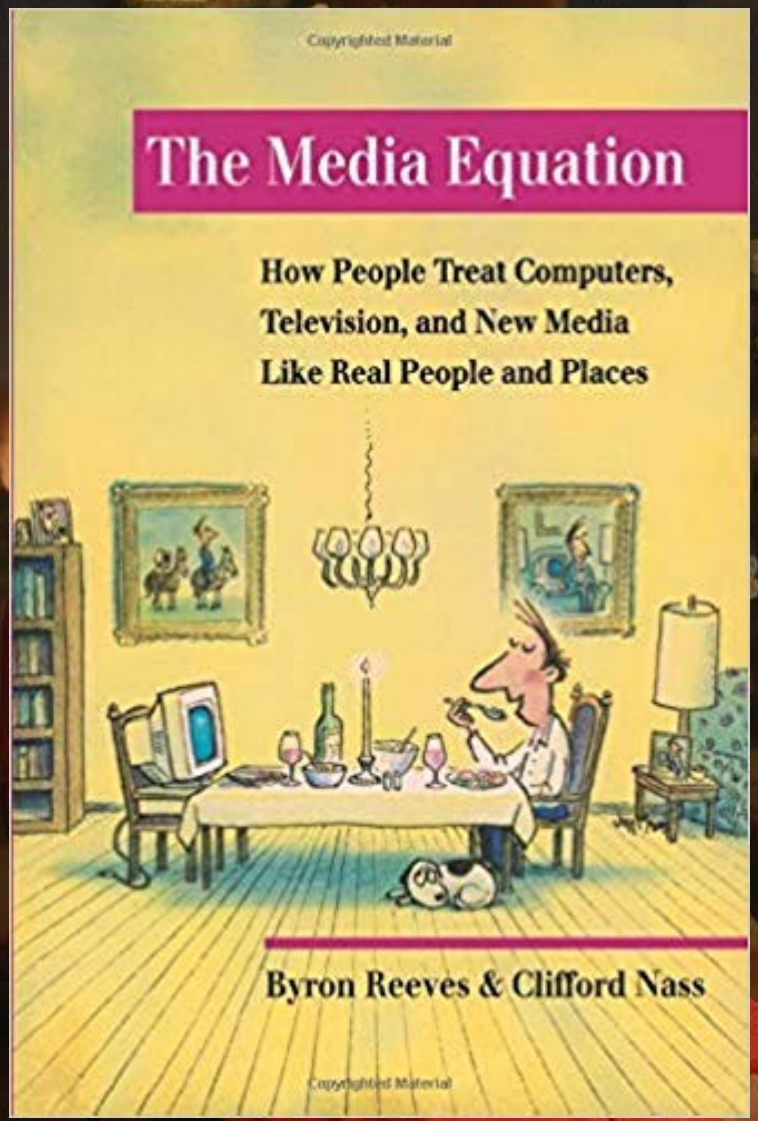
Treating Machines As Social Actors



AI-Driven Social Interfaces

Amazon Echo

Google Nest

Pepper

Nao

more social?

Goal & Learning Objectives

Goal:

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

Learning Objectives:

- 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
- Able to explain what robot interaction design is

Overview


ARTIFICIAL SOCIAL INTELLIGENCE
Designing a Social Robot Brain


THE SOCIAL ROBOT DESIGN SPACE
Effects of Robot Embodiment and Appearance


ROBOT INTERATION DESIGN (“IN THE WILD”)

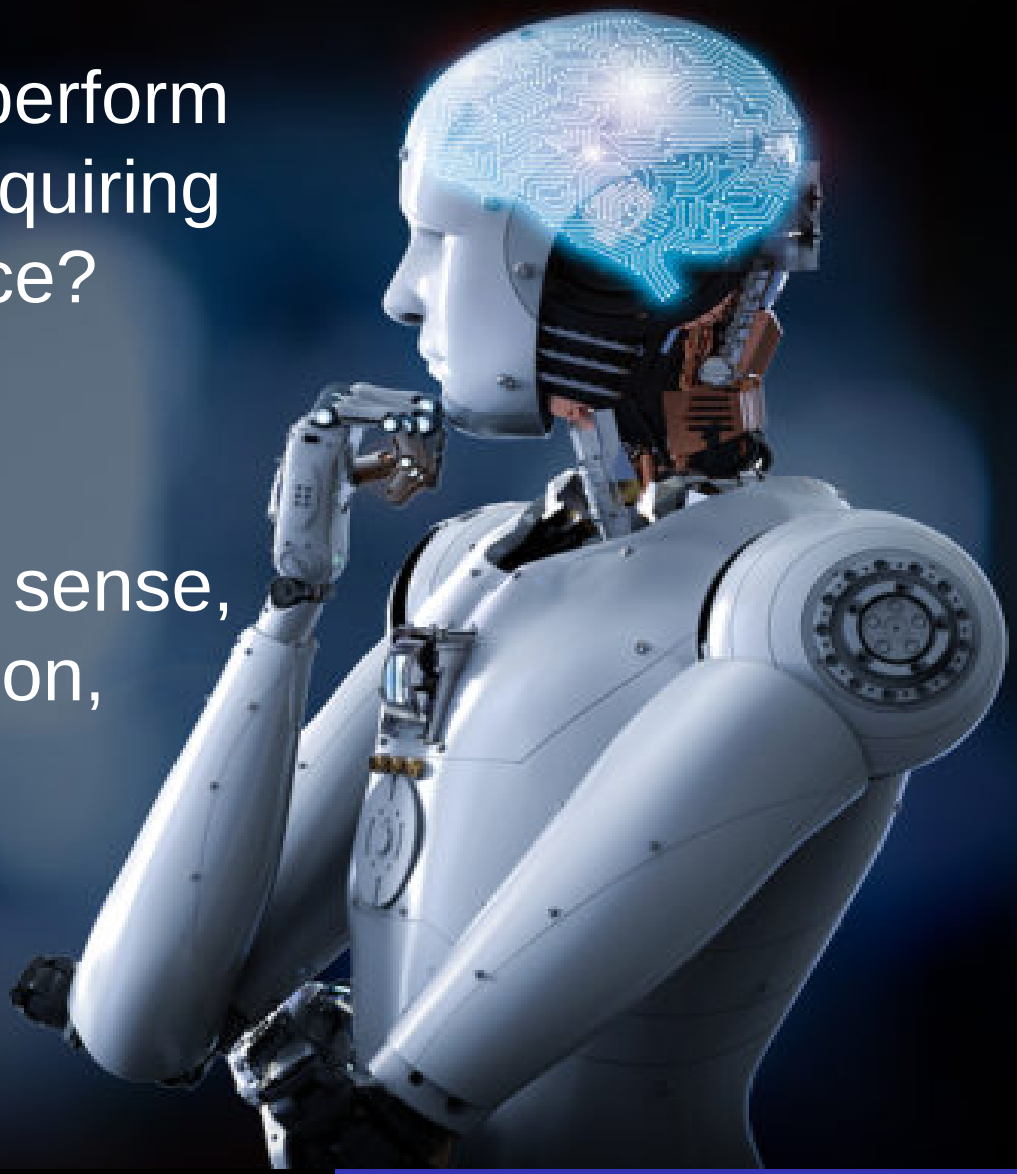
ARTIFICIAL SOCIAL INTELLIGENCE

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

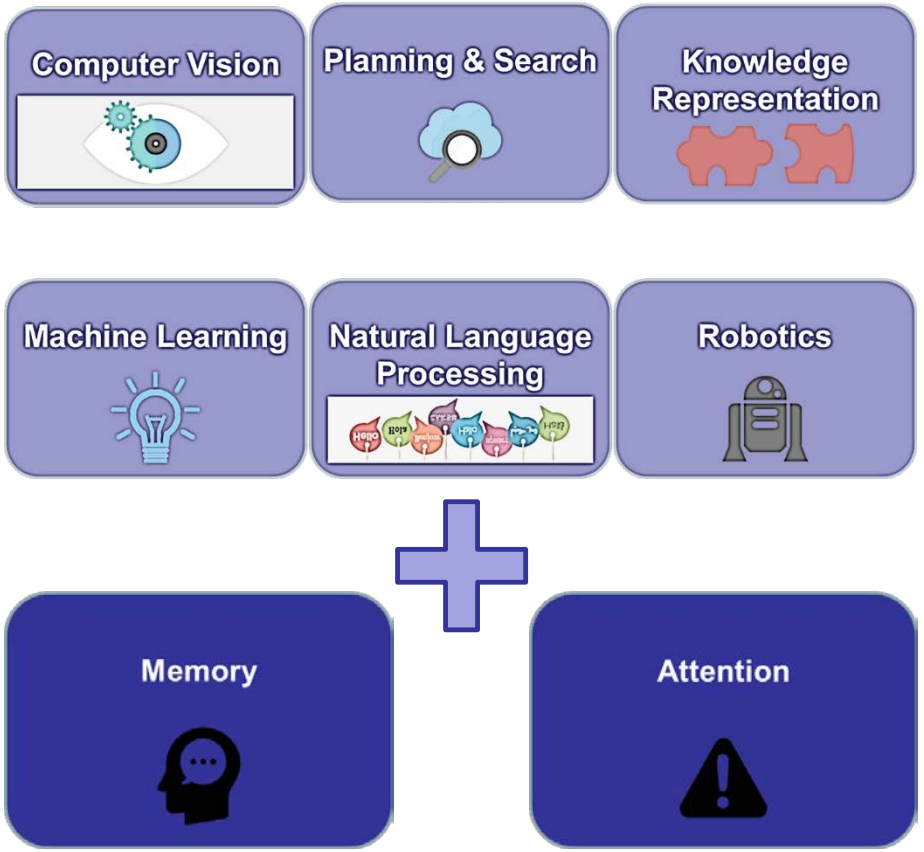
Knowledge Representation

Machine Learning

Natural Language Processing

Robotics

Social AI = Social Ψ + AI++



What is a Social Robot?

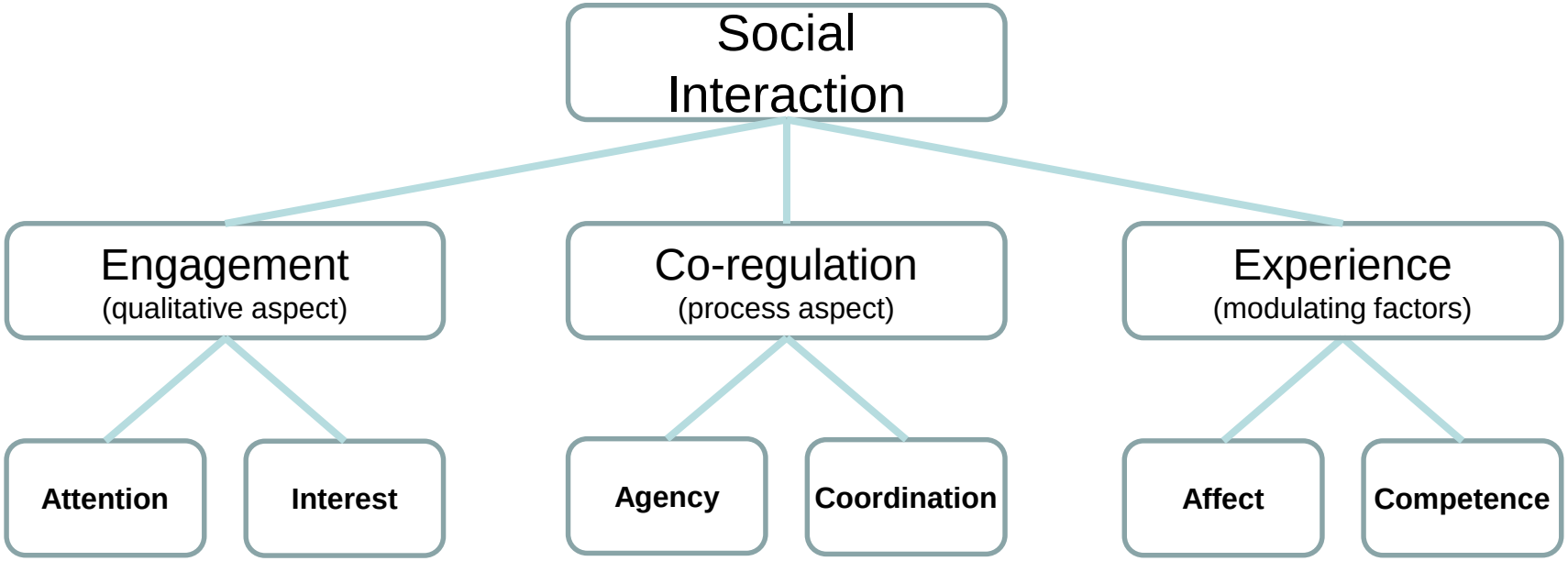
A social robot is a robot that is able to engage in social interaction with a human user

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?

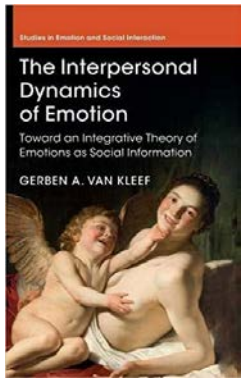
Progress =

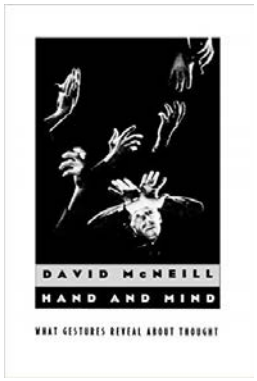
- more engaging:
  - maintain our attention more,
  - arouse our interests more, and
- more efficient interaction.
  - increased coordination,
  - Increased feeling of agency

Learning to Speak the Language of Social Interaction

+

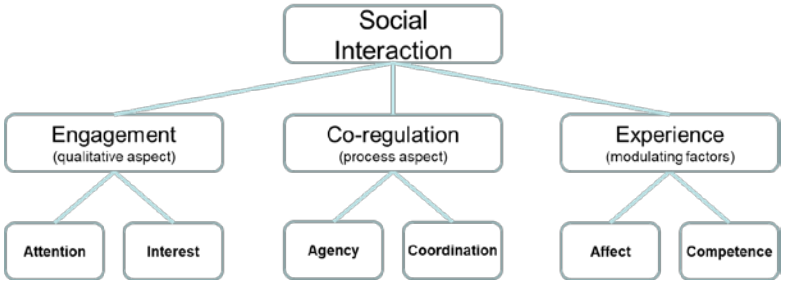
+





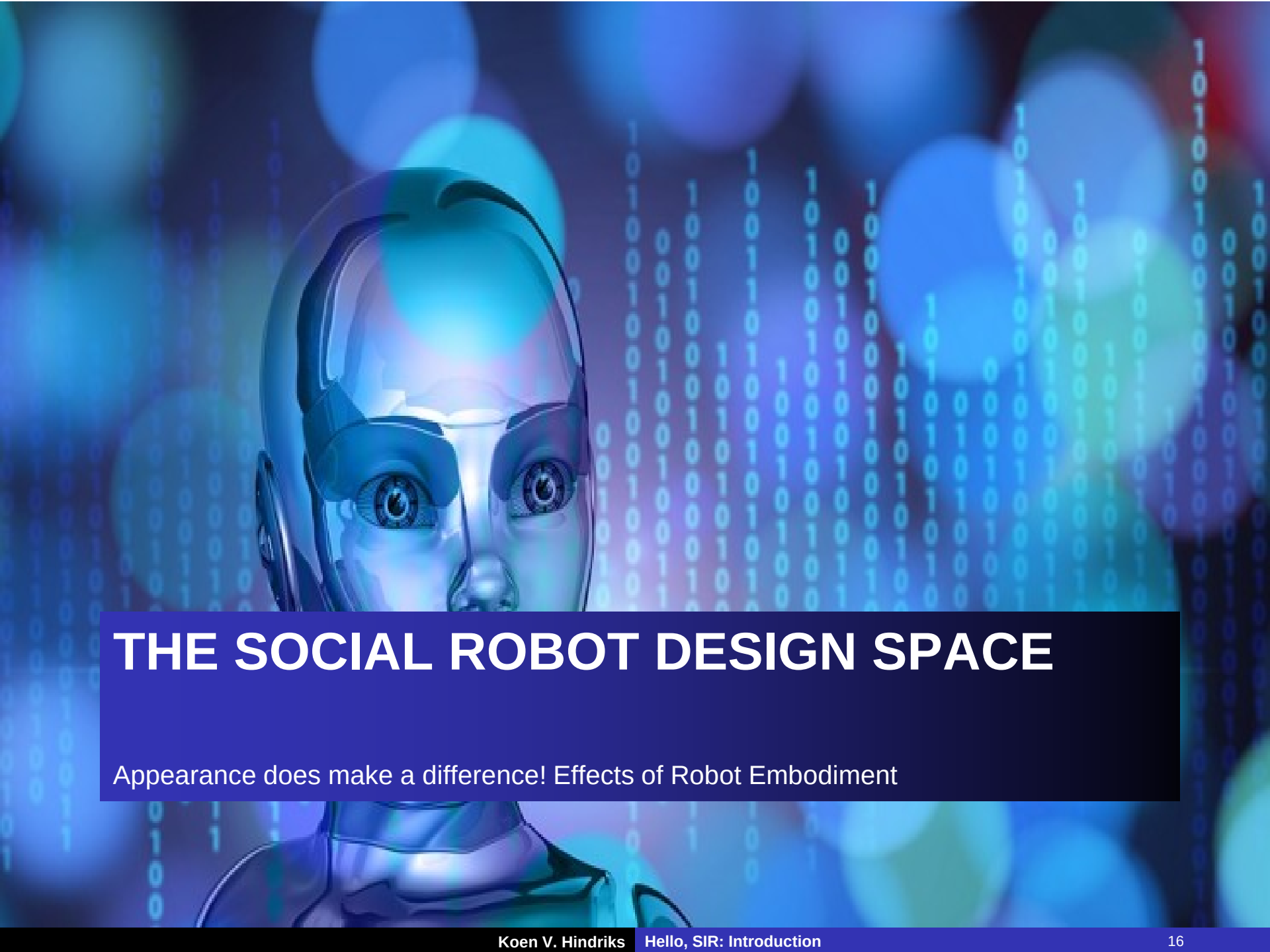
A two way street: Social awareness & presence

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 salience of 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

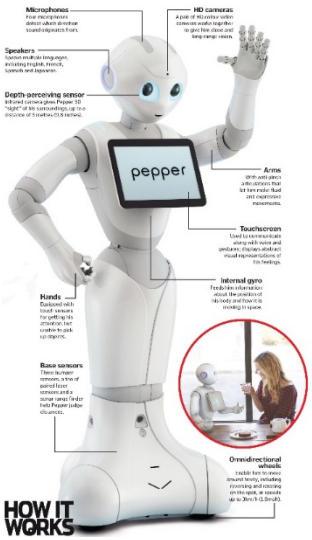
LG robot
2015

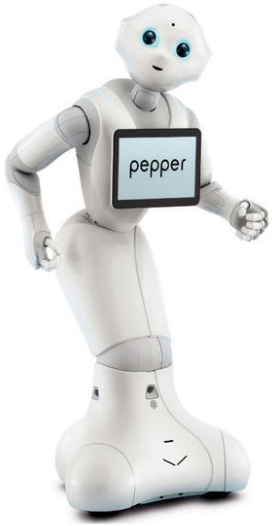
Mature Social Robot Platforms

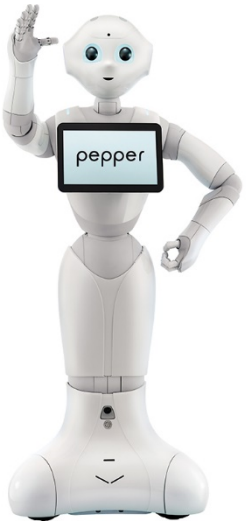
Robots with advanced capabilities.

‘Look & feel’ is right.

People like to interact with social robots.



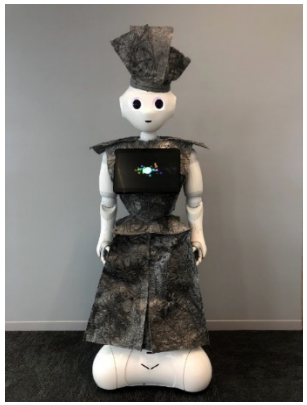


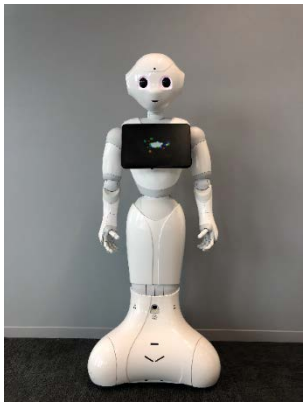


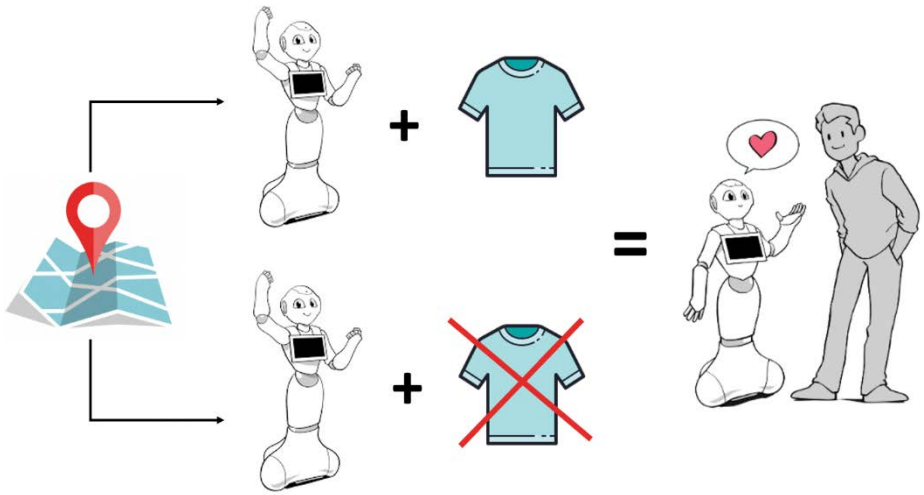
Appearances and Apparel

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

How does apparel affect users?



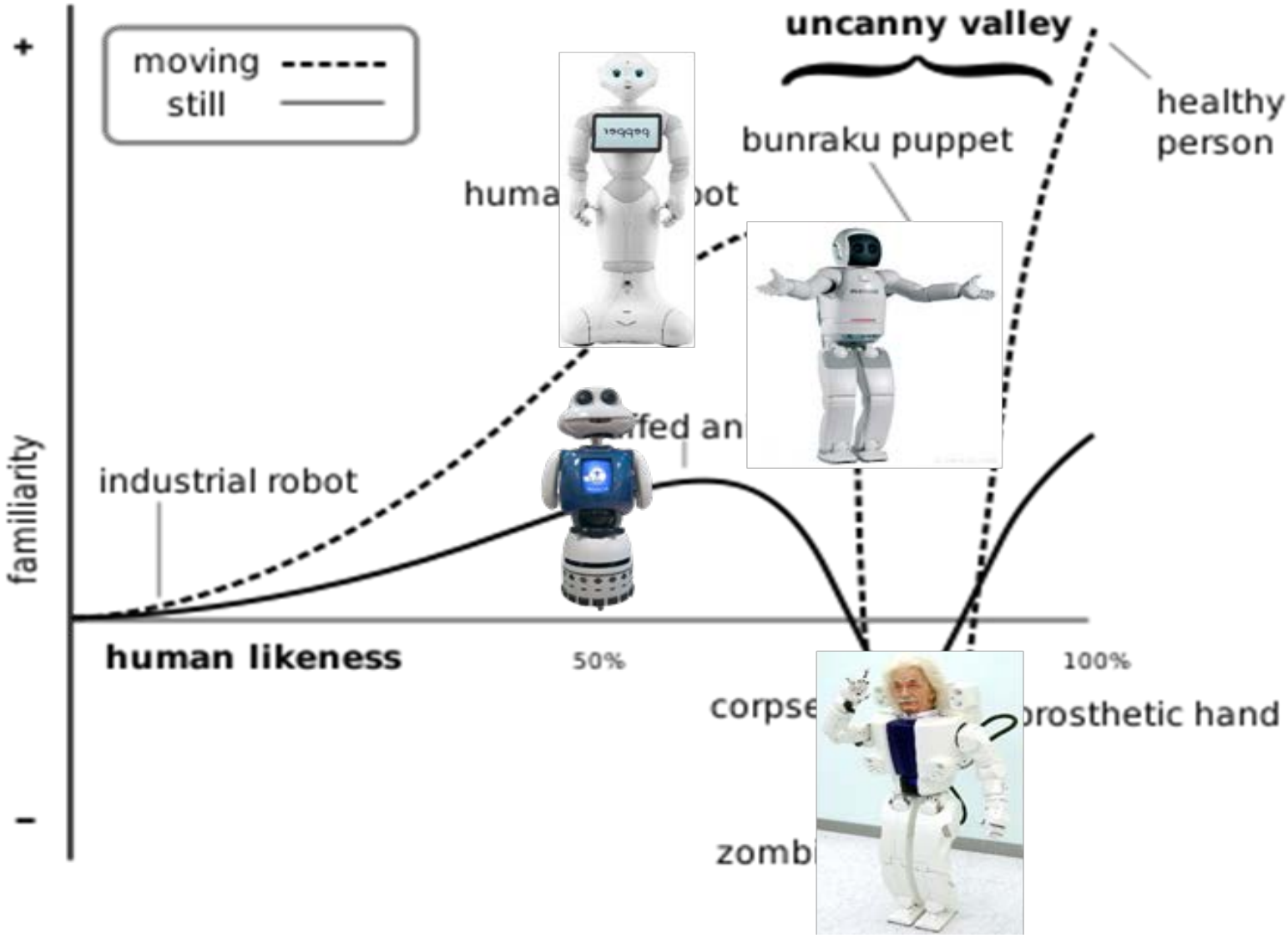




Robot Sophia

Robot Clones (Ishiguro)

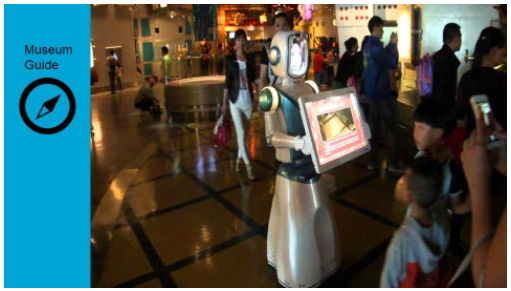
Uncanny Valley

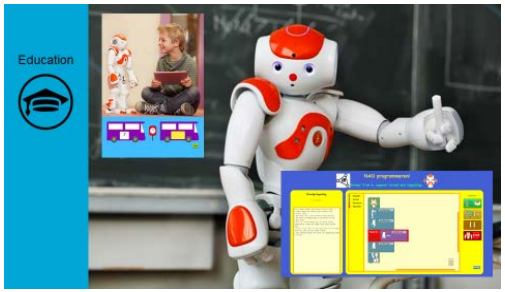


Hubots: Mimi is Anita in *Real Humans*

ROBOT INTERATION DESIGN (“IN THE WILD”)

Many Applications





Robot Interaction Design

- Robot interaction design is a type of interaction design where the choice of interaction technology is a **social robot**.
  - This does not mean there is no need for a **rationale** for this choice!!

This type of interaction design requires you to think about:

- **PACT** (People, Activities, Context, Technologies) principle(*):
  - People → in Design Doc: Target Audience, Personas
  - Activities → in Design Doc: Scenarios, Interaction Design
  - Context → in Design Doc: Application Context
  - Technologies in Design Doc: Social Robot subsection

(*) Benyon, David (2014). *Spaces of Interaction, Places for Experience: Places for Experience*. Morgan & Claypool Publishers

How can social robots be deployed in a retail setting?

KIEM RETAIL – MODEHUIS BLOK

Approach

1 Survey

Survey client base for tasks that can be delegated to a robot;

Based on typical customer journey model

2 Mockup

Create initial interaction designs for 1 or 2 scenarios;

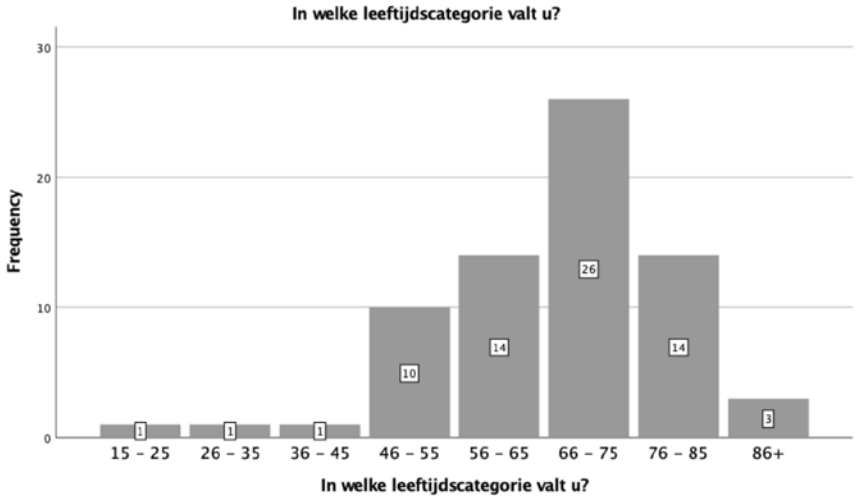
Have humans “act like a robot” and refine designs

3 WoZ

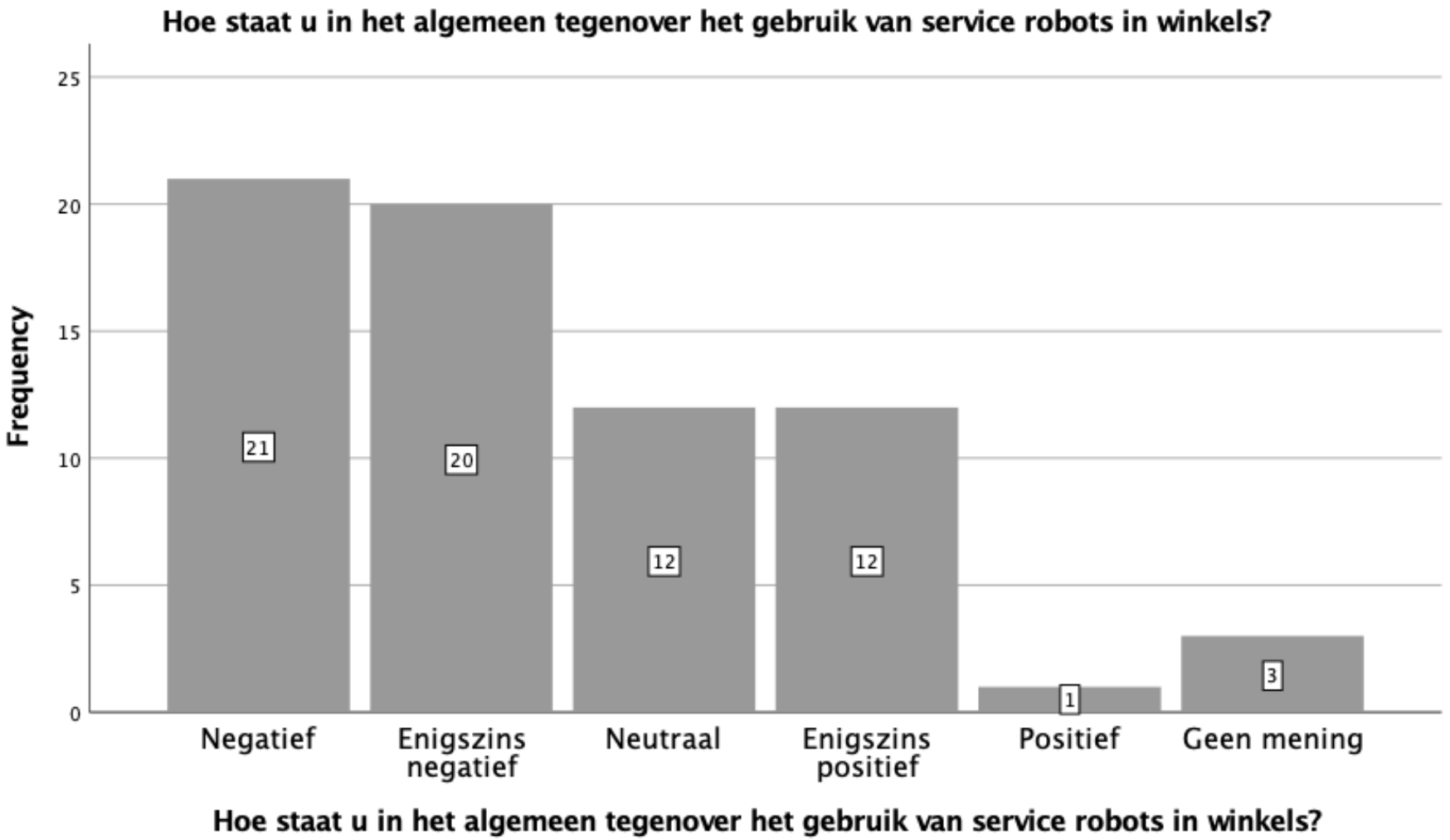
Implement designs for WoZ scernaio;

Analyze and evaluate feasibility and usefulness of scenarios for retail store

Demographics participants survey



Acceptance?


Hoe staat u in het algemeen tegenover het gebruik van service robots in winkels?
Frequency
25
20
15
10
5
0
21
20
12
12
1
3
Negatief
Enigszins negatief
Neutraal
Enigszins positief
Positief
Geen mening
Hoe staat u in het algemeen tegenover het gebruik van service robots in winkels?

Survey results current customer base

De ontwikkelingen op service robot gebied gaan snel. Service robots kunnen inmiddels voor heel wat taken worden ingezet. Hieronder geven wij een overzicht van deze taken. Geef per taak aan in hoeverre u hier een toegevoegde waarde in ziet voor Modehuis Blok

		Mij uitnodigen om de winkel te bezoeken	Mij meer vertellen over de coronapreventie in de winkel	Mij verwelkomen zodra ik de winkel binnenstap	Het wijzen van de weg in de winkel	Het communiceren van aanbiedingen	Het geven van productinformatie / voorraad nakijken	Het geven van persoonlijk (styling) advies	Het verzorgen van een stukje entertainment (bijv. spelletjes, quiz en/of dansje)	Mij vragen om mijn mening over de winkel
N	Valid	69	69	69	69	69	69	69	69	69
Mean		1.97	2.35	2.10	2.25	2.29	2.77	1.87	1.68	2.09

Univé Receptionist Robot

Hospitality

Bringing Requirements to Life: Personas

Persona = **Realistic** description of **typical** user

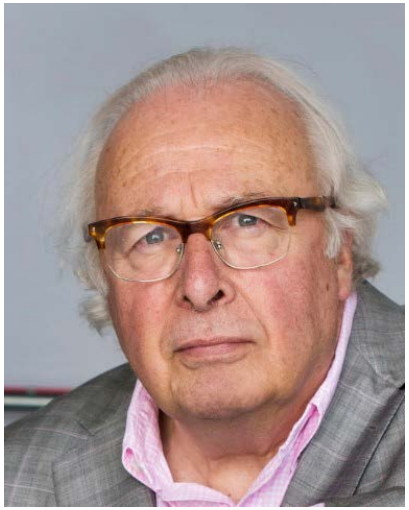
Description includes:

- persona **name** (and photo)
- a set of unique **goals** related to application (≠ demographics)
- user **behavior**, **attitudes**, **activities**, and/or **environment**
- **credible details** that help designers see personas as real potential users for which they can design

Why personas?

- To help designer make design decisions
- To remind that real people will be interacting with robot

Univé Persona: Mart



Name: **Mart**

User characteristics:
- **surprised**
- **interested**

User story: Seeks advise
Mart is on time for his scheduled meeting but is not too excited about this meeting. When Mart enters the store he is positively surprised by the fact that a Pepper robot is welcoming him into the store.

User goals:
- know more about insurance plans
- know more about what is covered by insurance
- get help and advise from insurance expert

How can we help:
- facilitate meeting with insurance expert
- provide more information about insurances
- entertain while waiting for adviser

Univé Persona: Melanie

Name: **Melanie**

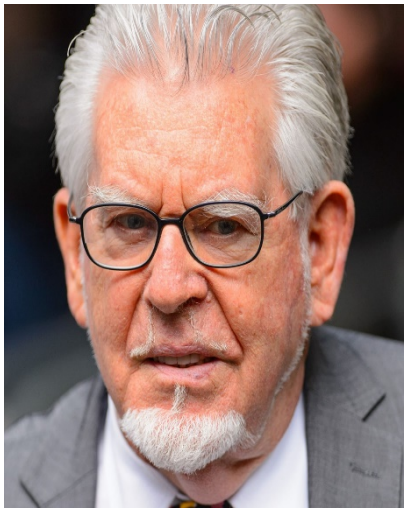
User characteristics:
- **worried**
- **focused**

User story: Needs help with insurance claim
Melanie hardly notices the Pepper robot welcoming her. She has just had an accident with her car and is worried about this. She is only interested in filling in the insurance claim form that she is holding in her hand while entering the store.

User goals:
- help with insurance claim
- know how to submit insurance claim
- get help and advise from insurance expert

How can we help:
- refer user to receptionist who can help setup meeting

Univé Persona: Rolf



Name: **Rolf**

User characteristics:

- **annoyed**
- **not comfortable talking to robot**

User story: Seeks advise

When Rolf enters the store he noticeably ignores the Pepper robot and walks in a big arc around the robot. He is not interested in interacting with the robot and dislikes that Pepper is welcoming him. He thinks it's best to remove the robot from the store!

User goals:

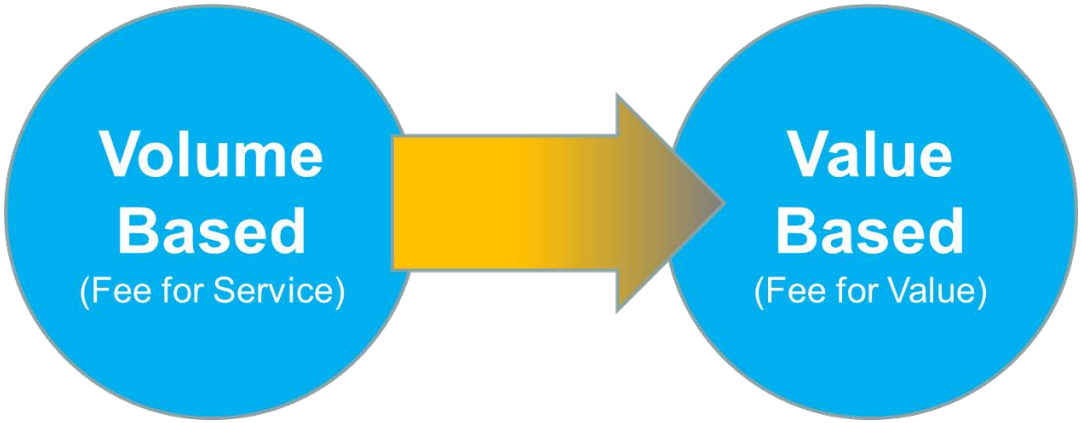
- know more about insurance plans
- know more about what is covered by insurance
- get help and advise from insurance expert

How can we help:

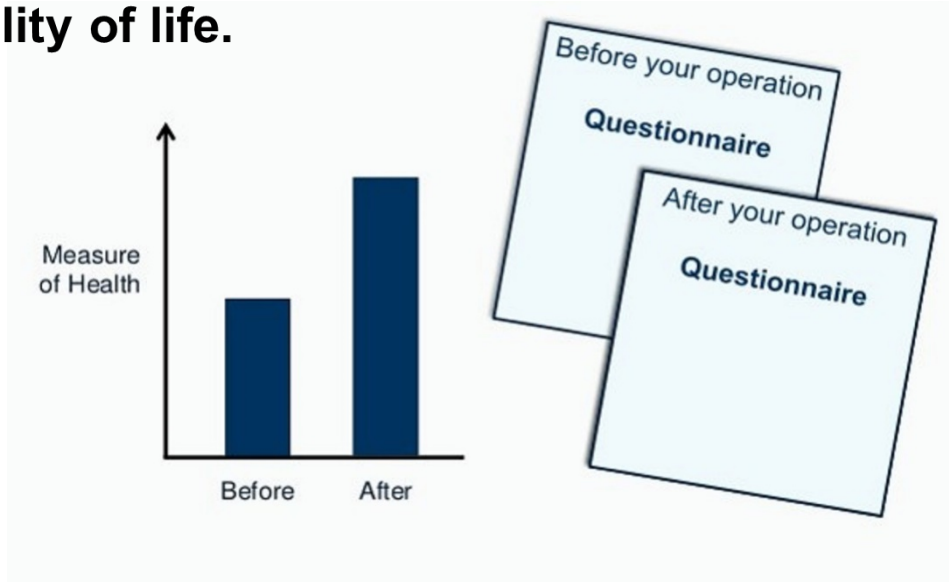
- facilitate meeting with insurance expert
- provide more information about insurances
- entertain while waiting for adviser

An Interview Robot for Collecting Patient Data in a Hospital

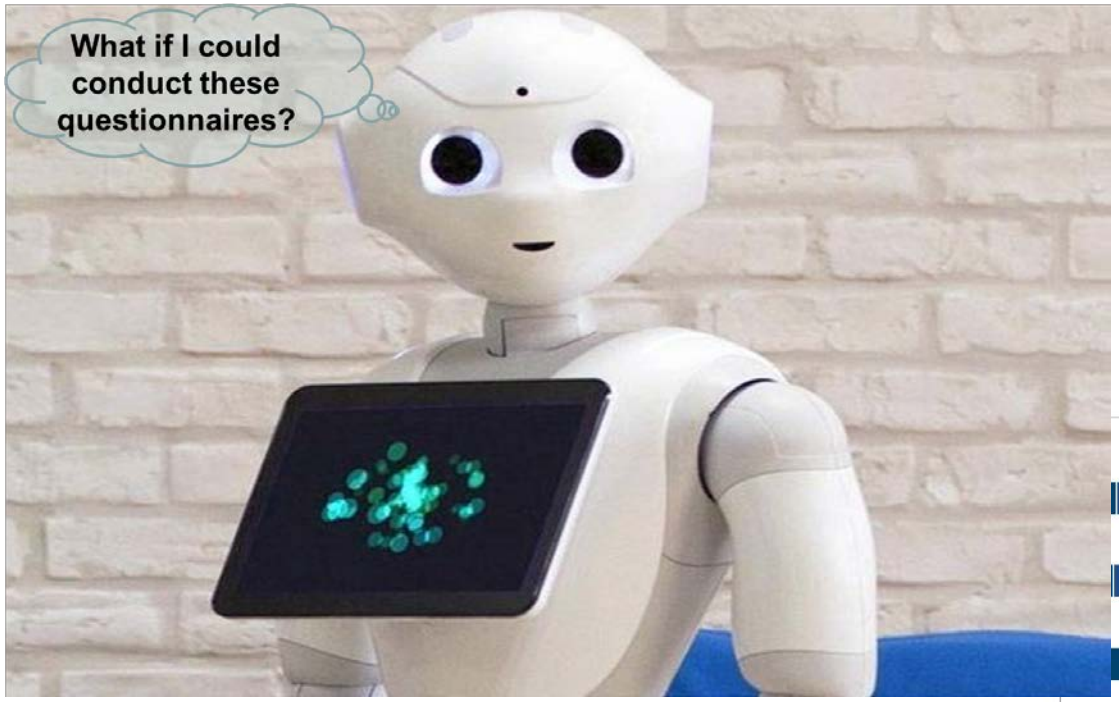
Value-Based Healthcare

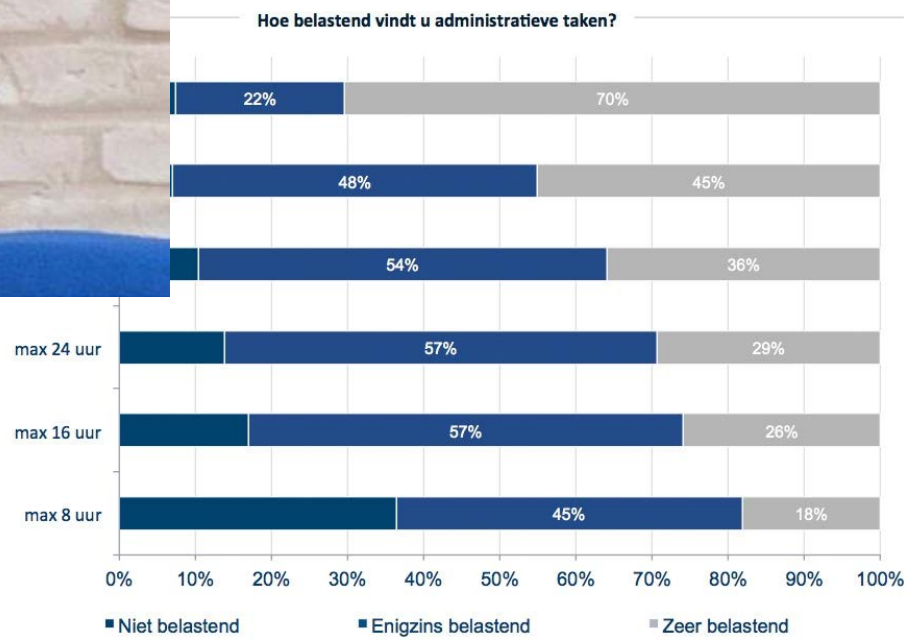


Requires measuring patient quality of life.



Capacity problem: Can a robot collect PROM data?





Administrative Burden >25%

Bringing Requirements to Life: Scenarios

Scenario = informal narrative description (‘story’)

- Describes **human tasks and activities in a story**.
- Uses the **vocabulary and phrasing of users** that can be understood by stakeholders.
- A **problem** scenario is a story about current, existing activities
- A **design** scenario is a story about how a robot can be used

Why scenarios?

- To help designer explore context, user needs and goals, requirements, and usability issues.

Problem Scenario

Charles is an elderly person who shows sometimes has difficulty to find his way home. He also forgets more often than he used to. He is a patient at the Radboudumc and receives a mail from the hospital to complete a questionnaire about the quality of his life one week before he has a visit scheduled with his physician.

One week later Charles arrives early at the Radboudumc hospital for a regular visit with his physician. He goes to the service desk to inform that he has arrived. He is asked to proceed to the geriatric department. *When he arrives a nurse checks whether he has completed the questionnaire. Charles has not done this*.

The nurse hands Charles an iPad to complete the questionnaire before the doctor will call him in. *But he is not very experienced with tablets and asks the nurse to help him out. The nurse conducts an interview and listens to the stories Charles has to tell about why certain things get more difficult in his life these days*. Charles thanks the nurse for her time before he is called in for his visit.

Design Scenario

Charles is an elderly person who shows sometimes has difficulty to find his way home. He also forgets more often than he used to. He is a patient at the Radboudumc and has a visit scheduled. Charles arrives early at the Radboudumc hospital for. He goes to the service desk to inform that he has arrived. He is asked to proceed to the geriatric department.

When he arrives at the department, a nurse checks whether he has completed a quality of life questionnaire. *Charles has not done this. The nurse shows Charles a picture of the Pepper robot (which he has not seen before) and asks Charles if he is OK with having Pepper conduct the questionnaire with him. The nurse explains that she will introduce Pepper to Charles and explain how to interact with it.*

Charles agrees and enters a room where Pepper is located. Pepper conducts the questionnaire with him and collects the quality of life data. When the questionnaire is completed, Charles leaves the room and continues to the physician's room for his scheduled visit.

Foundation: Robot-Administered PROMs

Operational demands (requirements derived from scenarios):
OD1: Robot must be **fully autonomous**.
OD2: Robot must be **reliable** data collector.
OD3: Robot must be **accepted** by patients.
…

Human factors:
HF1: Patients are **unfamiliar with social robot technology**.
HF2: Elderly patients **need help** to complete questionnaires.
HF3: Patients **need to have control** over interaction.
…

Implications for Experimental Design & Measures 1

RQ: Robot must be **fully autonomous**.

We need to come up with a **measure**.

Measure = percentage of sessions that one or more interventions were needed to complete the questionnaire.

When will we consider this requirement met?

Requirement met if >=90% sessions no intervention.

Implications for Experimental Design & Measures 2

RQ: Robot must be **reliable** data collector.

We need to come up with a **measure**.

Measure = distance to human collected data used as golden standard.

When will we consider this requirement met?

Requirement met if (specific) statistical analysis shows distance ‘is close’

Implications for Experimental Design & Measures 3

RQ: Robot must be **accepted** by patients.

We need to come up with a **measure**.

Measure = Almere Model (a Likert-scale 1-10 questionnaire; self-report).

When will we consider this requirement met?

Requirement met if average item-rating is >= 7.0.

Interaction Design Requirement & Claims

Requirement: (Robot must be reliable data collector) The answers that the robot collects from patients should match those that would have been collected by a caretaker as closely as possible.

Example

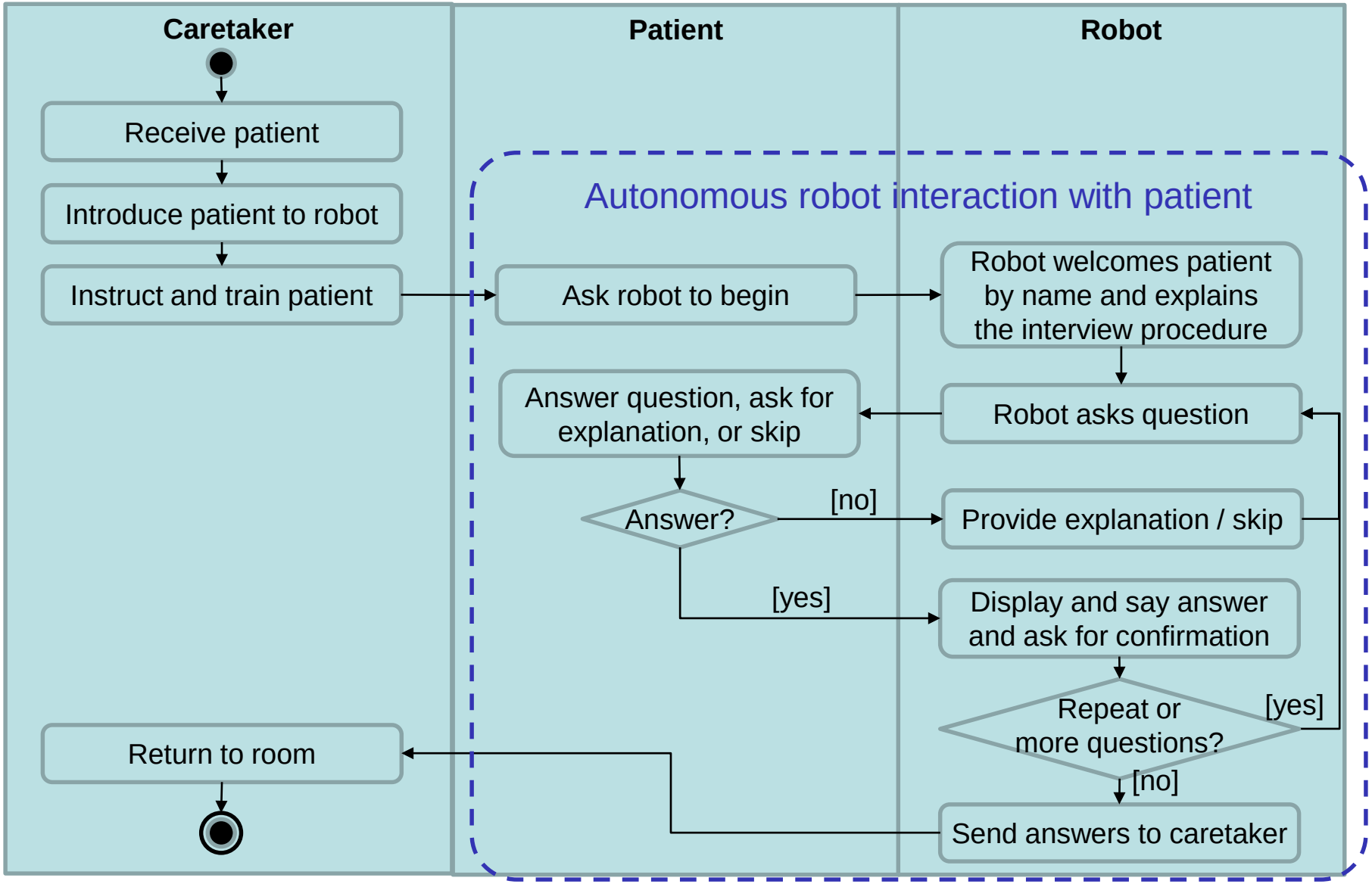
Claim:

<*upside*> By repeating the answer both verbally by means of speech as well as visually on the tablet, it will be clear to the patient which answer the robot recognized, resulting in clear feedback from the patient and therefore more reliable data collection.

<*downside*> It may be irritating when the robot continuously asks for confirmation, even if the robot varies the ways it asks for feedback, resulting in a decrease of appropriate attention and reduced data precision due to the patient becoming less engaged.

Function: (Ask for confirmation) After receiving an answer from a patient, the robot displays the answer it recognized on its tablet, verbally repeats the answer, and asks the patient to confirm the robot understood the answer correctly, while varying phrases used.

Interaction Diagram



Evaluation: Experimental Setup

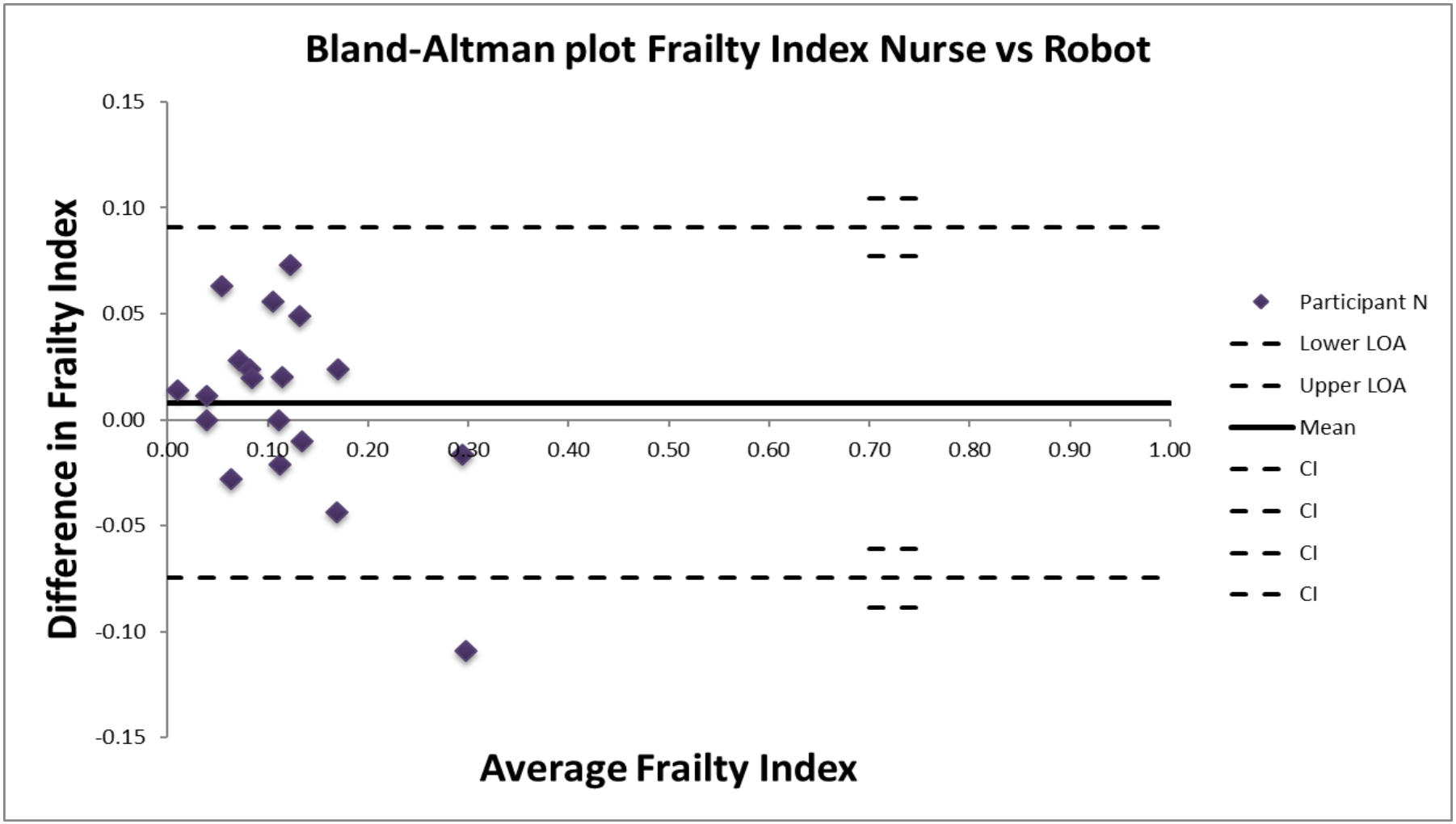
Fully Autonomous Robot

- 90% of interview scenarios completed without intervention by human.

	Duration Human	Duration Robot	Efficiency
TOPICS	4 min 11 sec	7 min 7 sec	170%
PWI	2 min 40 sec	2 min 38 sec	99%
RSNL	4 min 54 sec	6 min 51 sec	139%
Average			*136%*

- Very low correction rate needed.

Reliability: TOPICS-SF



Bias = 0.01 (on a scale of 0-1); Percentage error ranges from -58% to 75%.

Reliability of Data Collection

1

Robot data collection overall is a reliable method:

- Robot data for FI considered reliable enough, *but follow-up studies are needed to confirm this*.
- Robot data for PWI is considered reliable.
- Robot data for RI is considered reliable enough.

2

No significant diff. questions skipped (caretaker 3 questions skipped, robot 10 out of 1197; <1%).

3

No significant diff. wrt patient-initiated explanation explanation facility not often used (<5%).

Patient Acceptance

- Robot is positively rated by patients.

Variable	Score (0-10)
Attitude towards technology	7,2
Facilitating conditions	8,2
Anxiety	1,1
Perceived sociability	6,1
Social influence	5,4
Perceived ease of use	7,6
Social presence	5,2
Perceived enjoyment	6,2
Trust	6,4

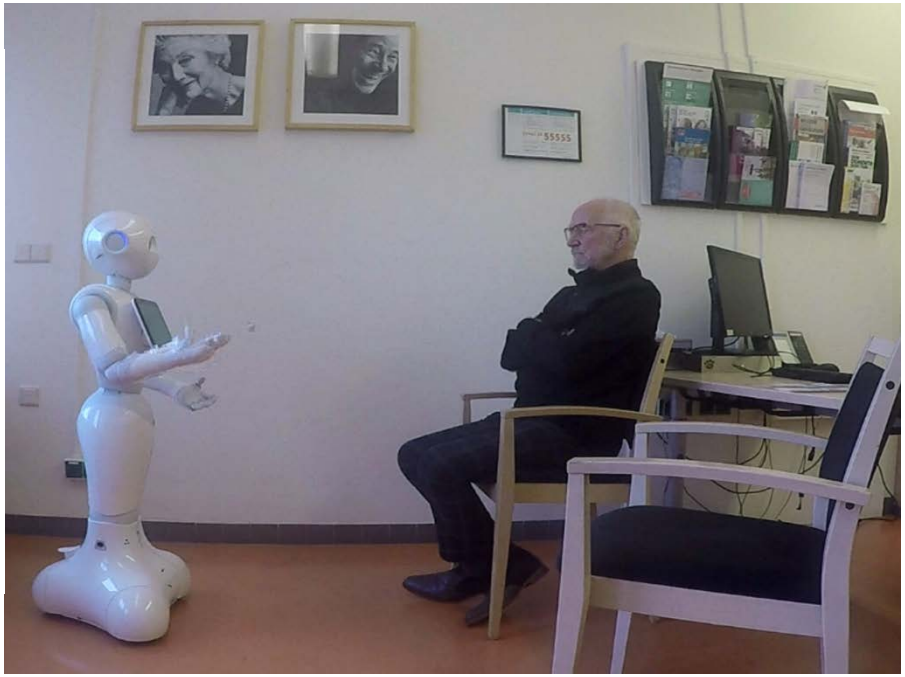
Qualitative findings:
How do patients interviewed by a robot feel?

4. Hoe tevreden bent u met wat u op dit moment bereikt hebt in uw leven?

Volledig ontevreden										Volledig tevreden
0	1	2	3	4	5	6	7	8	9	10

5. Hoe tevreden bent u met uw persoonlijke relaties?

Volledig ontevreden										Volledig tevreden
0	1	2	3	4	5	6	7	8	9	10



Key Findings & Future Ambitions

- Autonomous, reliable data collection robot; but sometimes robot cannot handle interaction:
  - *Future work*: How can a robot detect its own interaction capabilities are insufficient? And how to handover to a human (e.g. ask for help)?

- Robot is not sufficiently accepted yet by users; how can we improve patient acceptance?
  - *Future work*: Can we use social data (e.g. dialogues between caretakers and patients) to create more expressive robot interaction?
  - *Future work*: Can we develop a robot memory for personalization in repeated encounters?

Practical Assignment

- Develop your own prototype social robot use case.
- Use an (user-centered) interaction design approach.
- Work with Nao V6 robot.
- Report: Use Design Document Template
- Programming: NaoQi SDK / SIC Python API

- Interaction design & development: Work in groups of 6 or 7 in and outside the lab.

Summary & Homework

Homework:

- **Reading assignment**: See confluence course schedule! finish before lecture tomorrow (part of your grade!)
- **Watch tutorial videos** See confluence course assignment, week 1:
  - How to handle NAO! It’s an expensive robot.
  - Social Interaction Cloud tutorial videos.