UE Analyse du comportement, M2 SCMN

Analysis of behavior, Master 2 in Cognitive Sciences

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Planning of the UE Analyse du comportement, M2 SCMN

Day 1:

- some theory of human-robot interaction
- definition of research problem and protocol

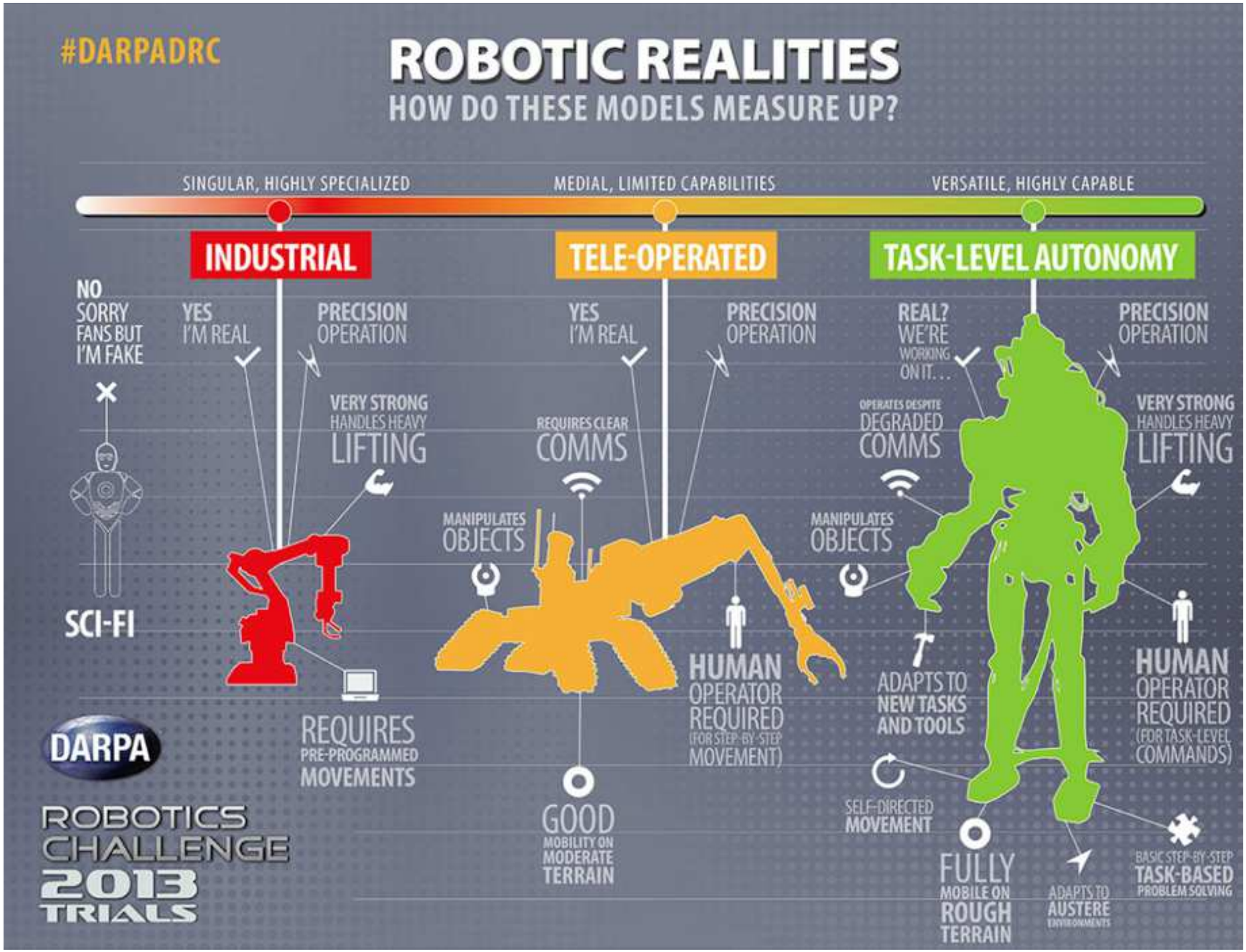
Day 2:

- practice: doing the experiments!
- 2 groups in the lab
- data collection

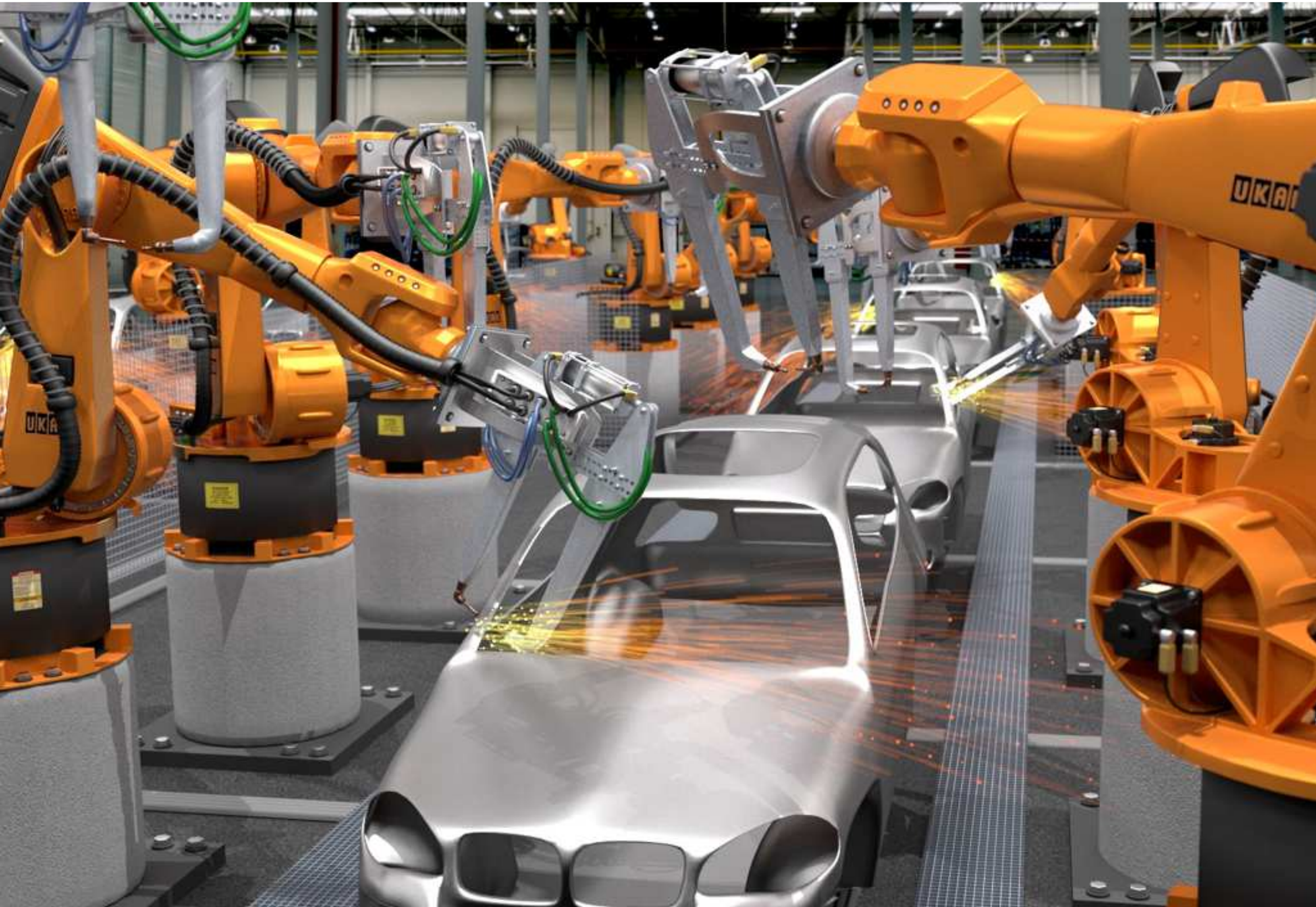
Day 3:

- post-experiment discussion & planning of data analysis
- some theory of human movement analysis

Robots now


#DARPADRC
ROBOTIC REALITIES
HOW DO THESE MODELS MEASURE UP?
SINGULAR, HIGHLY SPECIALIZED
MEDIAL, LIMITED CAPABILITIES
VERSATILE, HIGHLY CAPABLE
INDUSTRIAL
TELE-OPERATED
TASK-LEVEL AUTONOMY
NO SORRY FANS BUT I'M FAKE
YES I'M REAL
PRECISION OPERATION
VERY STRONG HANDLES HEAVY LIFTING
YES I'M REAL
REQUIRES CLEAR COMMS
PRECISION OPERATION
REAL? WE'RE WORKING ON IT...
OPERATES DESPITE DEGRADED COMMS
PRECISION OPERATION
VERY STRONG HANDLES HEAVY LIFTING
SCI-FI
REQUIRES PRE-PROGRAMMED MOVEMENTS
MANIPULATES OBJECTS
GOOD MOBILITY ON MODERATE TERRAIN
HUMAN OPERATOR REQUIRED (FOR STEP-BY-STEP MOVEMENT)
MANIPULATES OBJECTS
ADAPTS TO NEW TASKS AND TOOLS
HUMAN OPERATOR REQUIRED (FOR TASK-LEVEL COMMANDS)
SELF-DIRECTED MOVEMENT
FULLY MOBILE ON ROUGH TERRAIN
ADAPTS TO AUSTERE ENVIRONMENTS
BASIC STEP-BY-STEP TASK-BASED PROBLEM SOLVING
DARPA
ROBOTICS CHALLENGE 2013 TRIALS

In manufacturing



Teleoperation

Darpa Robotics Challenge

Semi-autonomous robots

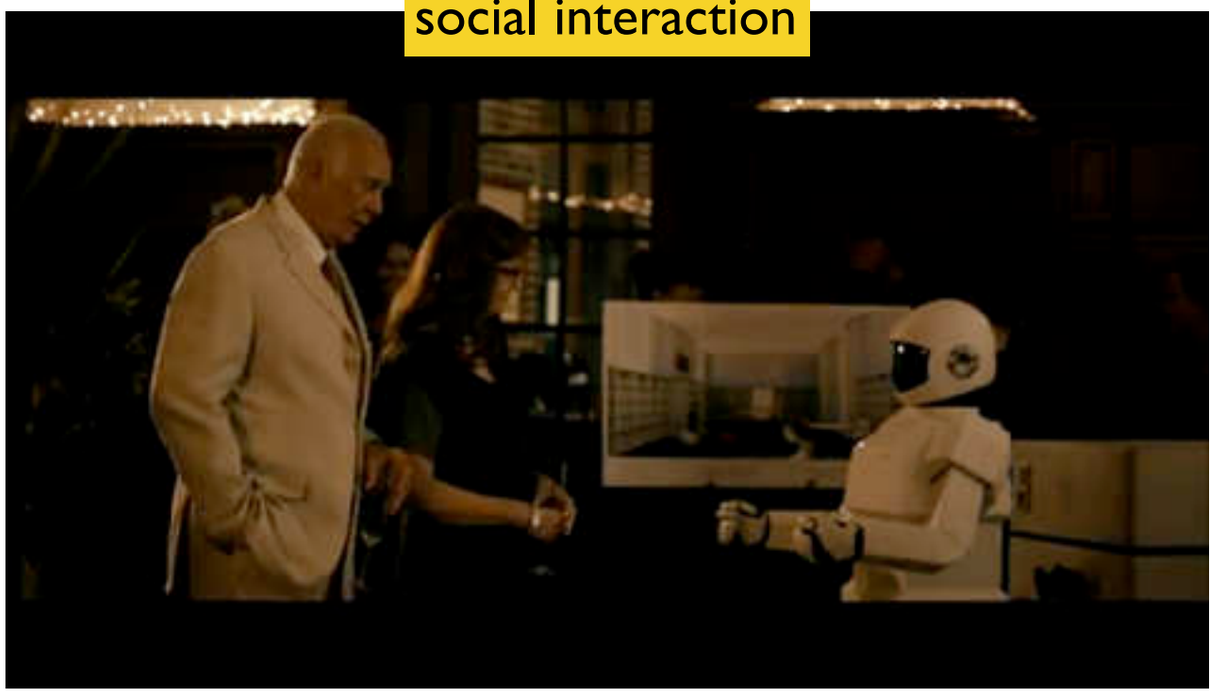
The future robot?

The future personal robot?

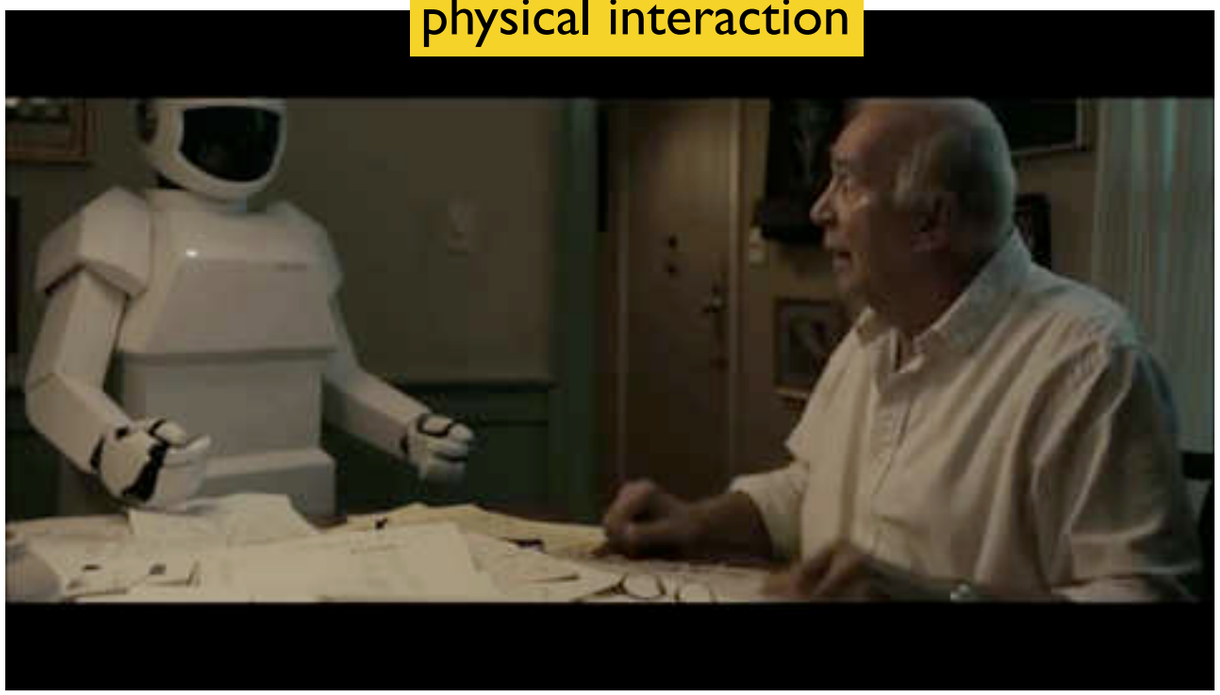
monitoring physical and cognitive health status

assistance in daily tasks

social interaction



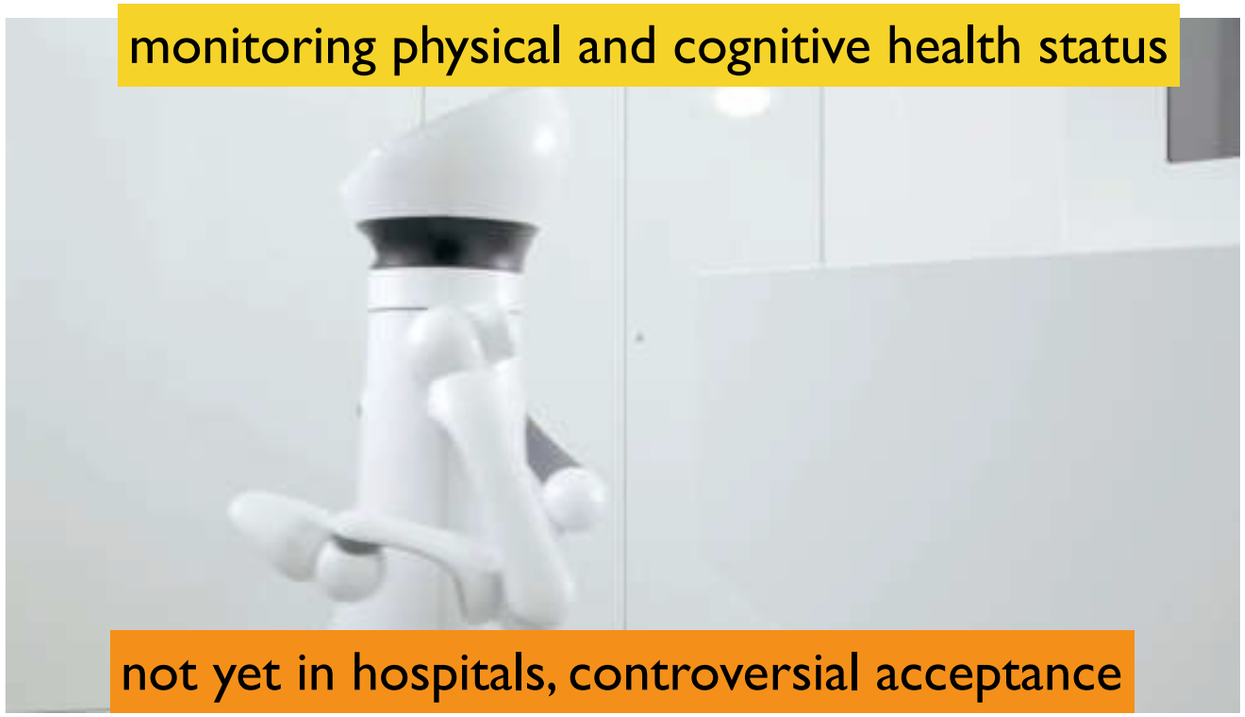
physical interaction



From the movie "Robot and Frank" (2012)

R&D towards the future robot

monitoring physical and cognitive health status

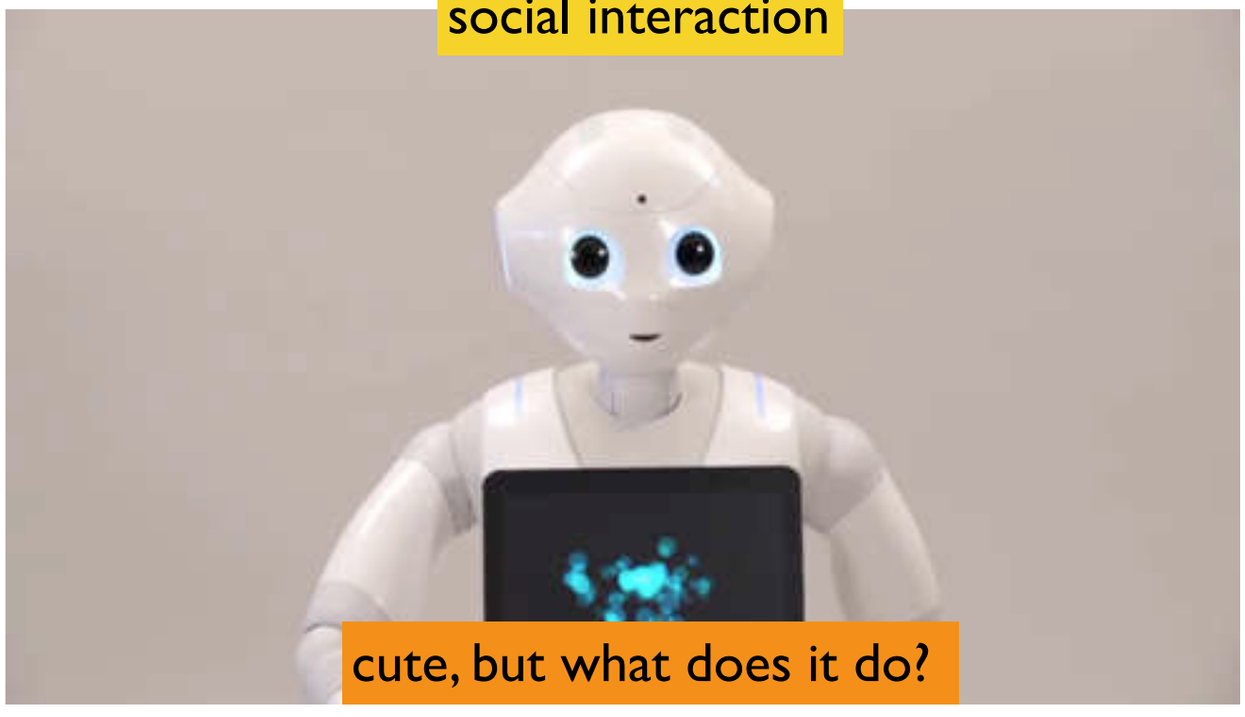


not yet in hospitals, controversial acceptance

assistance in daily tasks

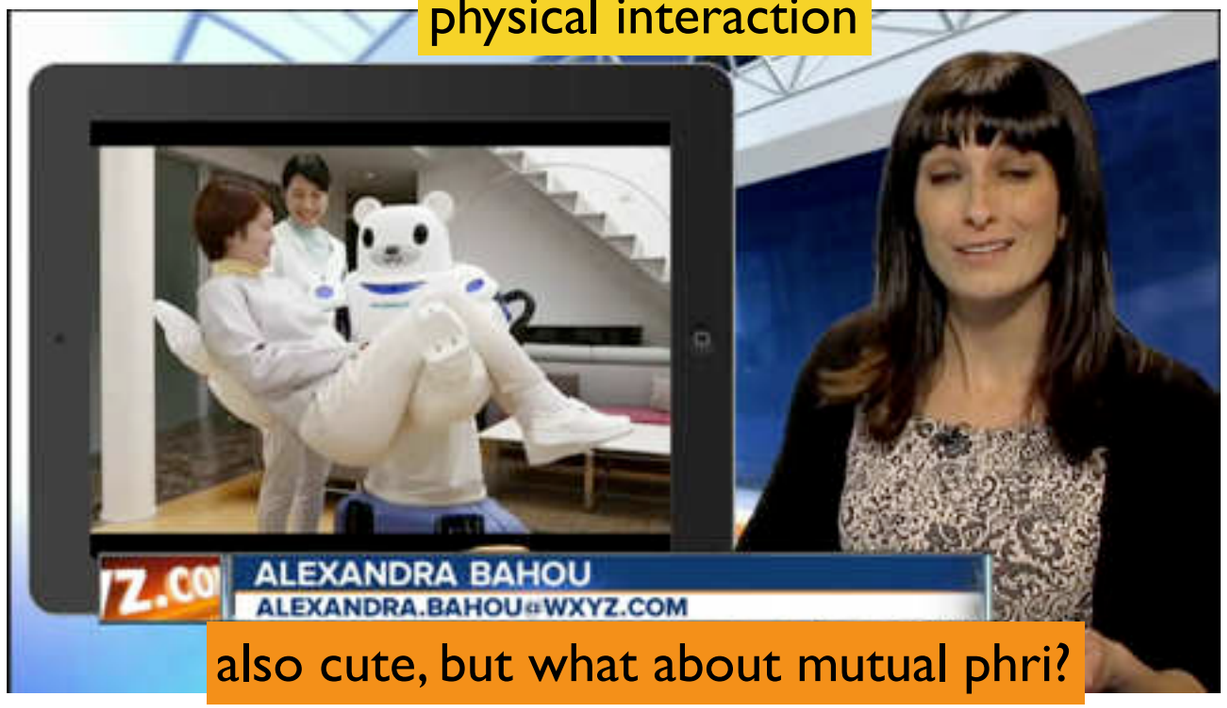
even the programmer is nervous to be touched

social interaction



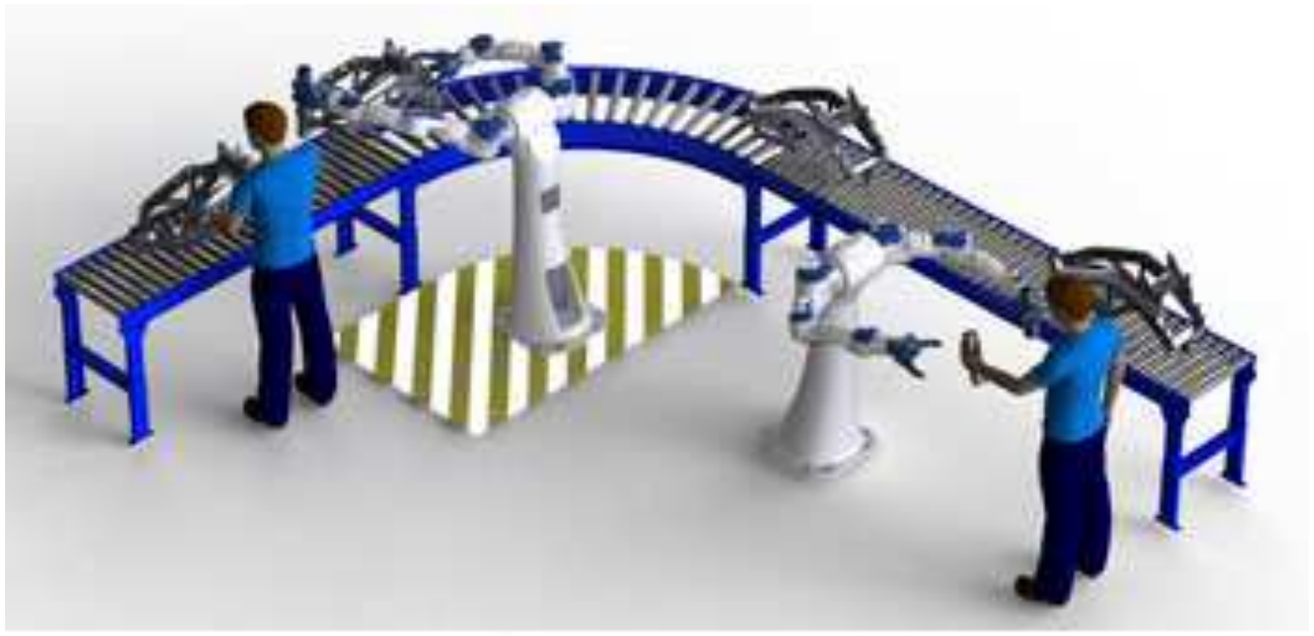
cute, but what does it do?

physical interaction

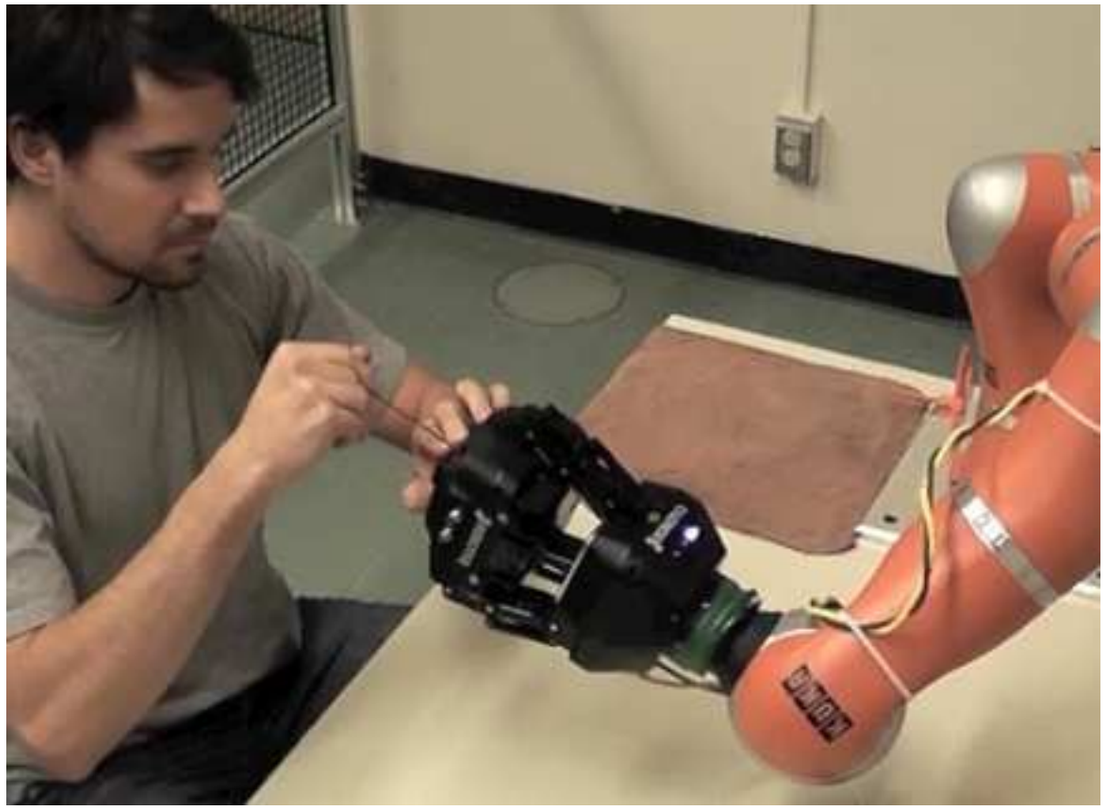


also cute, but what about mutual phri?

More and more Human-Robot Interaction



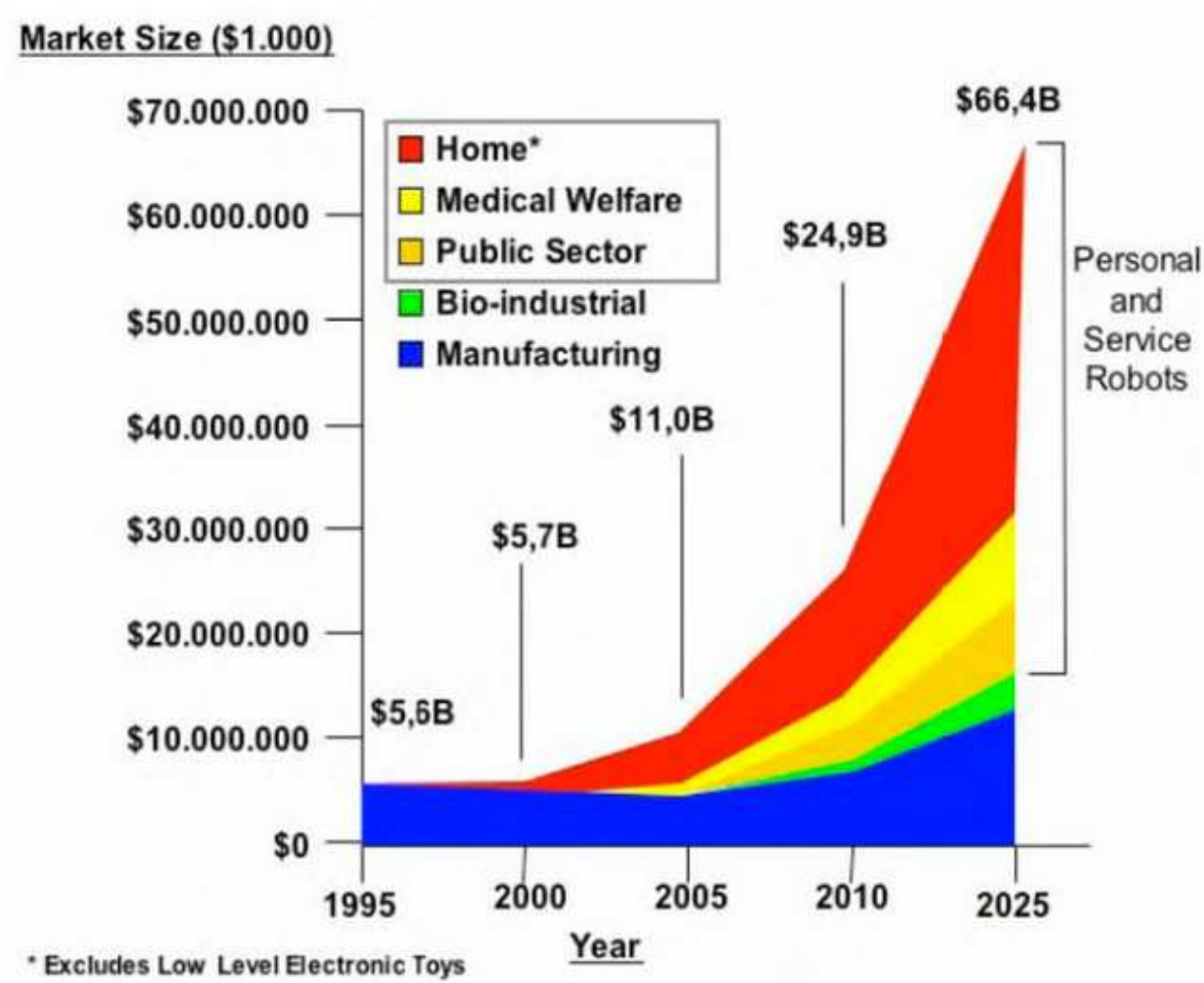
An assembly line model of collaborative robots working with human coworkers (Courtesy of Yaskawa Motoman Robotics, Miamisburg, Ohio)



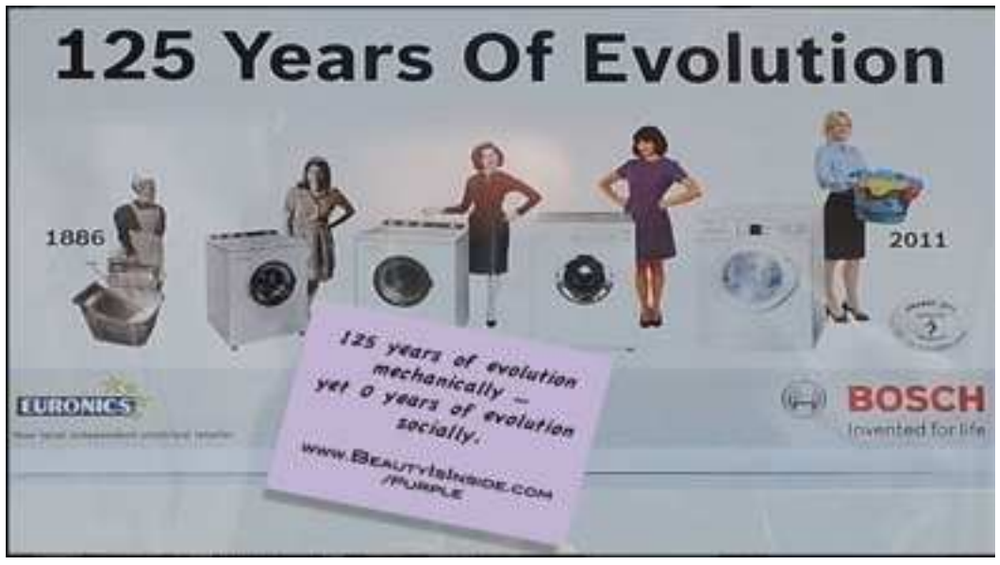
More and more Human-Robot Interaction

Mercedes' autonomous driving car

Market growth



Challenges for Human-Robot Interaction

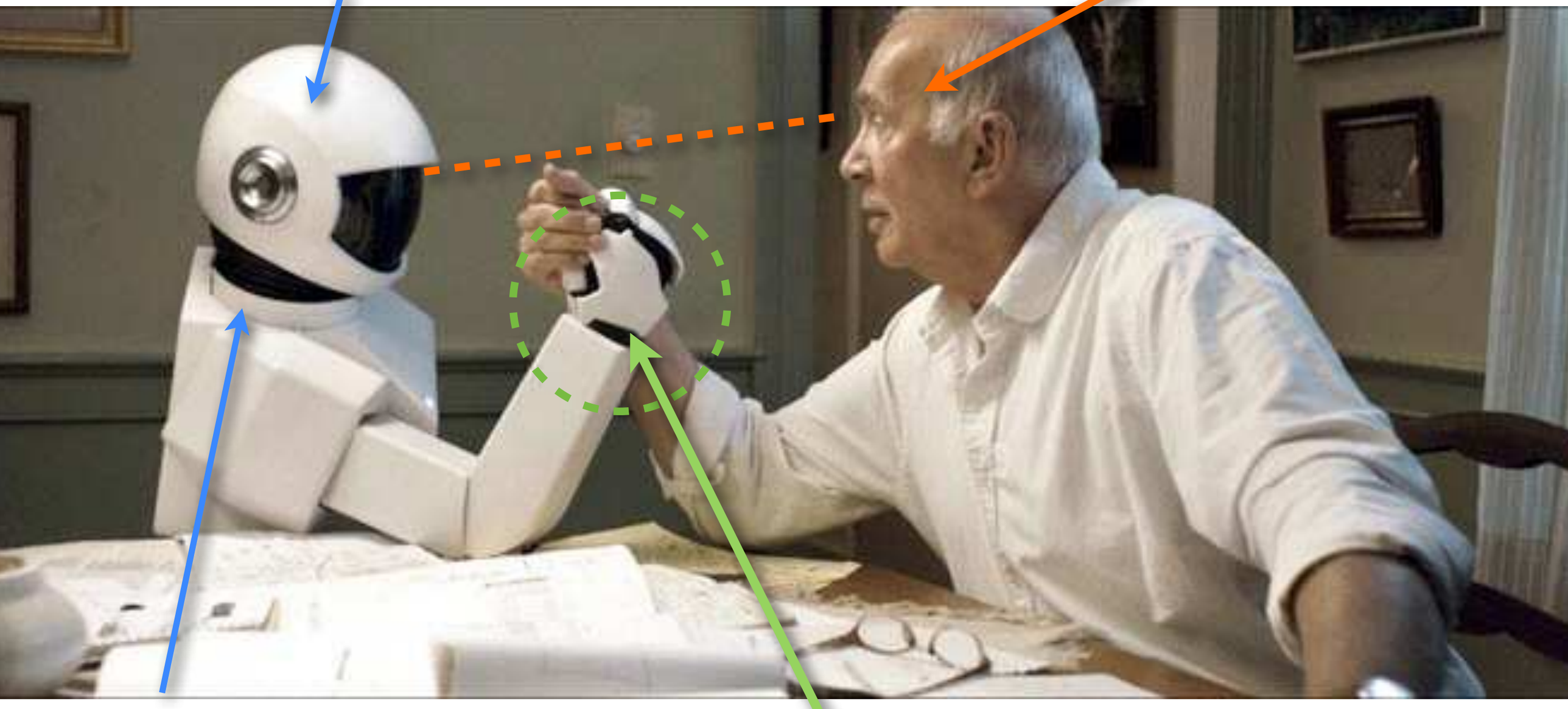


.. but robots do not always have buttons

The problem of communication

multimodal "behavior" control
(use/give feedback)

verbal/non-verbal signals



adaptation, learning

control of interaction forces

The robot perspective

What's the robot doing?

The robot perspective

What's the human doing?

The robot perspective

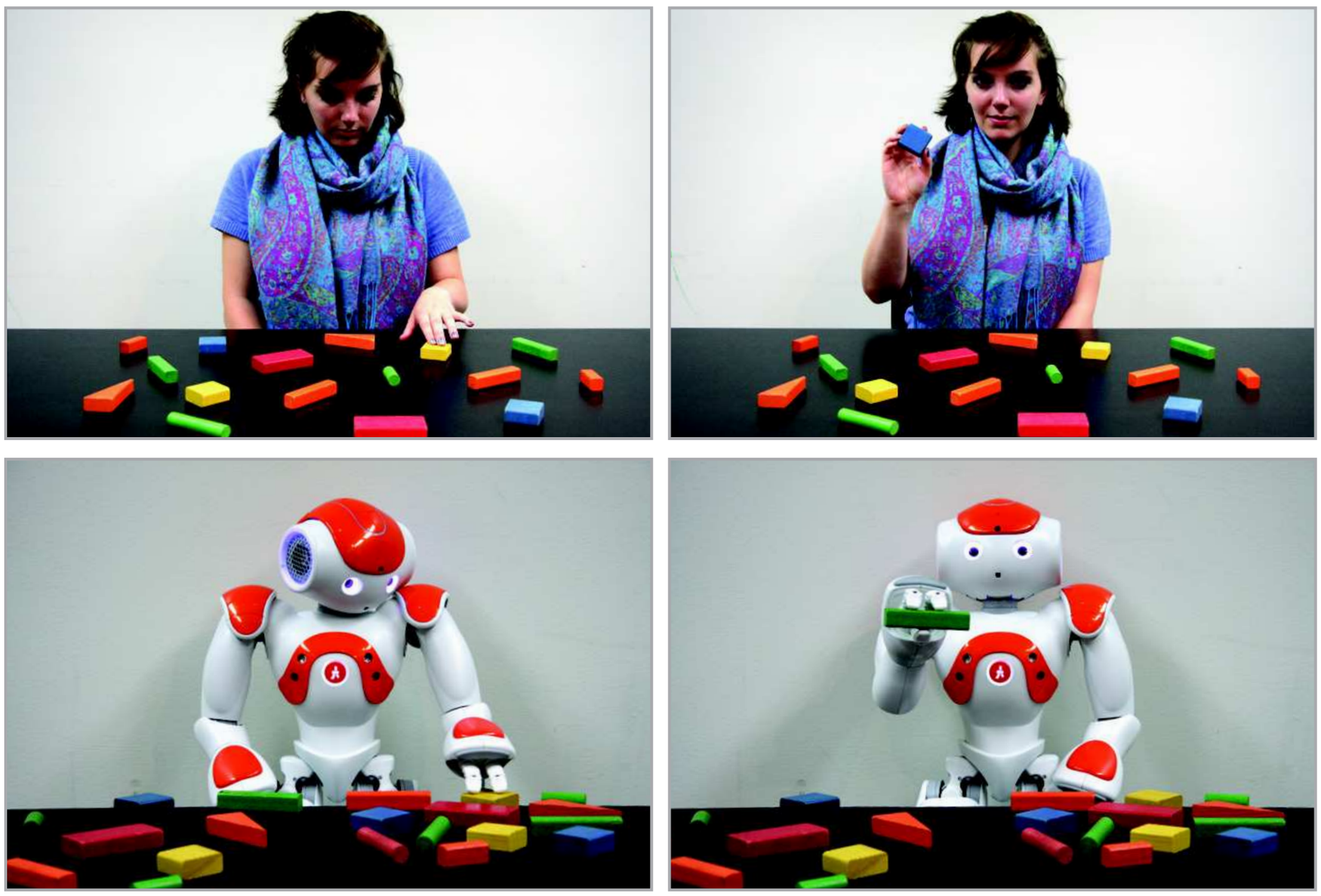
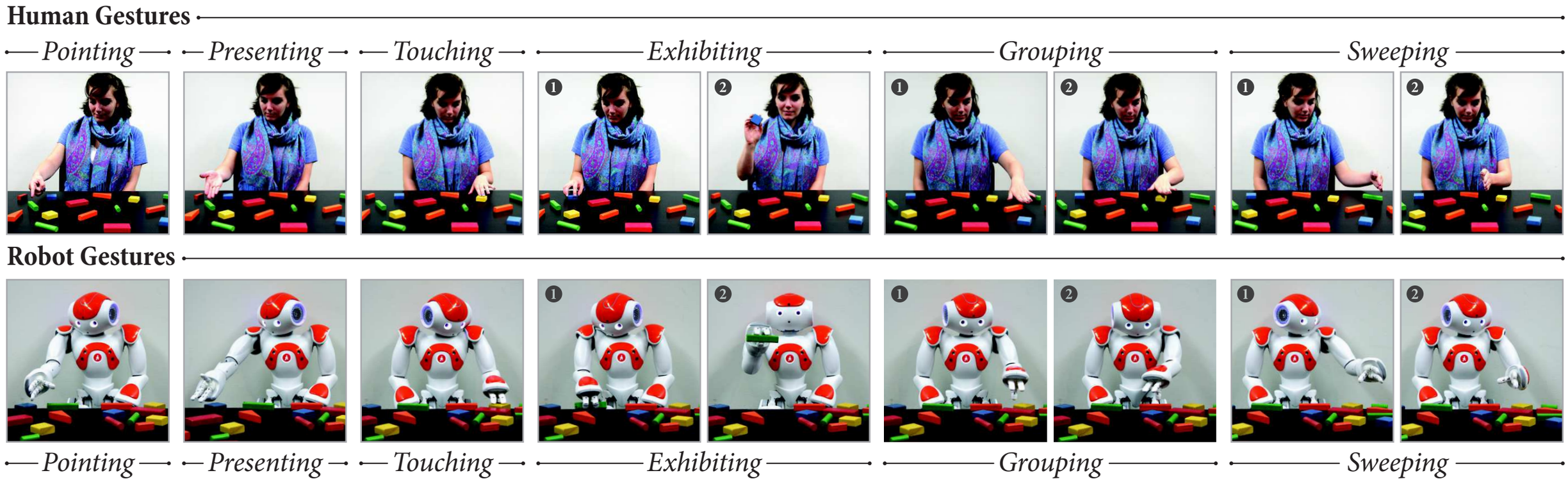


Figure 1: Examples of human deictic gestures *touching* and *exhibiting* and their equivalent implementations on the NAO robot.

Source: Sauppé & Mutlu , Robot deictics: how gesture and context shape referential communication, HRI2014

The robot perspective



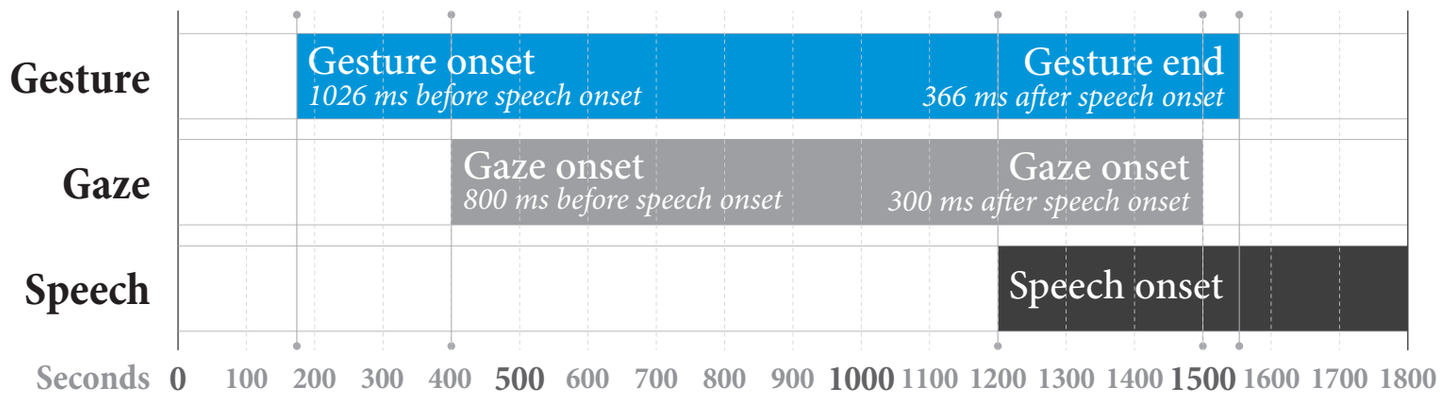


Figure 3: A model of the gesture-contingent gaze behavior implemented in our study. Start and end times are relative to the onset of speech.

Source: Sauppé & Mutlu , Robot deictics: how gesture and context shape referential communication, HRI2014

Challenges for Human-Robot Interaction

- **People using / collaborating with a new technology**
  - **Acceptance**
  - **Trust**
  - **Adoption of the technology ("appropriation")**

- Lack of exposure to robotics before
  - What should I do with it?
  - How should I do it?

- Lack of proper training or education
  - what do you do when the dishwasher is broken?
  - what will you do when your robot will malfunction?
  - how do you know when it is not working?

- New interaction modalities
  - robots do not always have buttons
  - some interactions cannot be reduced to buttons

Challenges for Human-Robot Interaction

- What can we observe / evaluate / study ?
  - Human behavior
  - Robot behavior
  - Patterns of interaction: the single, the duo, the many
  - Influence of sociological and psychological factors
  - Subjective evaluation

- Why is it important?
  - Feasibility
  - User experience
  - Efficiency
  - Safety
  - Impact on the user / society
  - Improve robots
  - … a way to study humans too!

Preparing an experiment

Why:

- we want to understand a phenomenon
- test an hypothesis
- study the impact of a factor on the outcome of an action or event
- better understand the human

In HRI:

- test design decisions or algorithms for robots
- study, understand and ultimately model the human (brain)

How to design a good experiment:

- step by step process
- control the experiment: hypothesis, conditions, units, etc
- avoid confounds
- log everything
- objective and subjective measures
- make it repeatable

Checklist for an experiment

Definition of protocol:

1) The research question
2) Hypothesis
3) Conditions
4) Experimental units / participants / population
5) Assignment method / study design
6) Variables
7) Mesures & metrics

Protocol validation with pilot study

Experiments

8) Data analysis
9) Discussion

Writing report

Preparing an experiment

1) The research question

- what is the problem
- what is your goal: exploratory study, find quantitative evidence, test a new hypothesis, describe a phenomenon, …
- prior literature, prior knowledge, prior facts, prior observations
- previous results, observations and intuitions should help you formulate hypothesis

2) Hypothesis

- independent variable: x
- dependent variable: y
- x affects y
- directional hypothesis: x negatively/positively affects y, x is negatively/positively correlated to y
- hypothesis should be developed before running the experiments!

Preparing an experiment

Confound:

- confound is a variable whose effect cannot be distinguished from the effect of another
- they often vary with an independent variable
- example:
- We hypothesise that A influences B.
- We find that A correlates with B.
- We also find that C correlates with A.
- Is A influencing B or C influencing B?

Preparing an experiment

3) Conditions

- independent variables
- in medical experiments: drug vs placebo
- in robotics:
  - random vs proposed algorithm
  - algorithm A vs algorithm B vs algorithm C
  - with speech vs without speech
  - scenario: collaborative vs competitive vs neutral

Preparing an experiment

4) Experimental units, population, participants

- target of your experiments
- in medical experiments: humans / patients / participants / subjects
- in biology experiments: cells, animals
- in robotics:
  - benchmarks for algorithms
  - human-robot interaction: humans / users / participants
  - potential end-users vs students from university
- studies with humans:
  - children, young, adults, elderly
  - healthy, impaired, medical conditions
  - psychological and medical issues
  - approbation from an Ethics Committee: not mandatory in human-robot interaction, but advised; mandatory for medical studies

Preparing an experiment

5) Assignment method or study design

- assign conditions to experimental units

  - between-subjects: each unit is assigned one condition
    - no confounds introduced by ordering of conditions
    - many units are required to achieve statistical significance

  - within-subjects: all experimental units are assigned all conditions
    - requires less units, because all units do all the conditions
    - this design introduce learning-based confounds
    - order of presented conditions should be randomised
    - sometimes not possible to realise (e.g., drug testing)
    - used for comparing algorithms: we test algorithms A,B,C on all benchmarks X,Y,Z and compare results

  - “mixed" design: units receive one condition for some variables, all conditions for other variables

Preparing an experiment

Assigning conditions and avoiding confounds

- between-subjects: each unit is assigned one condition
  - randomization: randomly assign participants to conditions

- within-subjects: all experimental units are assigned all conditions
  - counterbalancing the order of conditions
  - example: for three tasks (ABC), compute all permutations and assign to subjects: ABC, ACB, BAC, BCA, CAB, CBA
  - N tasks → N! permutations

Preparing an experiment

6) Variables

- linked to the hypothesis
- <u>independent variables</u>: what we are manipulating in the conditions
- <u>dependent variables</u>: what we measure
- <u>covariates</u>: factors that may in our population and we don't (or can't) manipulate
  - we need to control the population to ensure that the variation of the covariates is balanced across conditions
  - for example, the gender of participants: we test condition A vs B with N participants, it would be good that the number of females and males in groups A and B are balanced
- <u>stimuli</u>: used to provoke events, so that we have multiple measures
  - good for statistics
  - variable stimuli can help in generalize the findings

Preparing an experiment

7) Mesures & metrics

- what we measure: signals, attitudes, feelings, impressions, …
- how we measure: sensors, questionnaires, self-reports, …
- specify pre- and post-processing
- task metrics & performances
  - success rates, error frequency, …
  - task duration, …
- subjective measures
  - questionnaires
- objective measures
  - number of events / actions, frequency, durations
  - automatic processing
  - manual annotation

Metrics for Human-Robot Interaction

Some types of measures:

- physiological measures
- behavioral measures
- focus-groups
- semi-directed interviews
- questionnaires

Some reading:

- Steinfeld et al. (2006) Common Metrics for Human-Robot Interaction. ACM Int. Conf. HRI.
- Young et al. (2010) Evaluating human-robot interaction: focusing on the holistic interaction experience. Int. Journal of Social Robotics.
- Anzalone et al. (2014) Evaluating the engagement with social robots. Int. Journal of Social Robotics.

Methods

- Physiological measures
  - Stress and anxiety: skin conductance, heart-rate
  - Physical workload, effort, comfort, fatigue
  - EEG, EMG
- Advantage: objective input to match the questionnaires and the subjective evaluations
- Disadvantage: not easy to obtain in natural interaction settings, requires wearable sensors; analysis is often complex

Methods

- Behavioral measures
  - Gaze
  - Speech
  - Body posture & proxemics
  - Gait & whole-body movements
- Advantage: objective measures, quantifiable
- Disadvantage: requires sensors

Behavioral measures

Study	Ref	Social signals used to assess the engagement
Castellano et al., 2009	[9]	Gazes towards the robot Smiles
Ishii et al., 2011	[25]	Gazes Towards the object the agent is talking about Gazes Towards the agent's head Gazes Towards anything else
Ivaldi et al., 2014	[26]	Reaction time to the robot attention utterance stimulus Time between two consecutive interactions
Le Maitre and Chetouani, 2013	[28]	Utterance directed to the robot Utterance directed to self
Rich et al., 2010	[41]	Gazes Focused (man and robot are looking at the same object Gazes Mutual (man and robot look at each other) Utterance Adjacent (two successive locutions, produced one by the robot, the other by the human, separated by a maximum interval) Utterance Responses (the subject responds to the robot through a gesture or a very short verbal intervention)
Sanghvi et al., 2011	[42]	Postures (curve and inclination of the back)
Sidner et al., 2004	[45]	Gazes Shared (mutual or directed) Gazes Directed towards the robot without the latter looking at the human
Sidner et al., 2005	[46]	Gazes Shared (mutual or directed) Gazes Directed towards the robot without the latter looking at the human

Table 1 Social signals used in literature as metrics for the assessment of engagement.

Methods

- Focus groups
  - usually 1 experimenter as leader/moderator, 1 experimenter as "secretary", then 4/5 subjects
  - exploratory: the researcher explore the participants' attitudes, ideas, expectations
  - structured around topics or problems to solve
- Advantage: can find the unexpected
- Disadvantage: can be difficult to analyse, can come out with something unfeasible or no answer

- Semi-directed interviews
  - One-to-one interviews led by the experimenter
- Advantage: can explain in-depth
- Disadvantage: statistical analysis is very long

Methods

- Standardized questionnaires
- Questionnaires are designed to gather data from the participants, that can be analysed statistically
  - Pre-experiment
  - Post-experiment
    - Likert scale questionnaires
    - Dichotomous questions (e.g., yes/no)
    - Ranking order of preference
    - Filter questions
- Advantage: easy to analyse
- Disadvantage: bias in the answers, bias from the designer of the questionnaires

Likert scale questionnaires

- Likert items are used to measure attitudes to questions or statements. The answer is coded with a number on a given range, .e.g. 1-5 or 1-7.
- Example:
    - 1=strongly disagree
    - 2=disagree
    - 3=neutral
    - 4=agree
    - 5=strongly agree

- We cannot use the mean of a single item as a measure of central tendency (what it the mean of strongly agree and disagree?)
- We can compute the mode (most frequent response), the median, the distribution of answers.
- We can use mean on Likert scales for comparisons, to test hypotheses, but this requires a suitable hypothesis test (e.g., Mann Whitney)

Likert scale questionnaires

- Likert scales suffer from distortion effects:
  - Central tendency bias:
    people avoid using extreme response categories
  - Acquiescence bias:
    tendency to agree to statements as they are presented
  - Social desirability bias:
    people alter their answers to behave as the experimenters would like to, or to portray themselves or their opinions in a better light

Task-specific metrics

- task performance: how well human+robot accomplish a task together
  - time-to-completion of a task
  - throughput: number of items, frequency
  - frequency & impact of errors
  - success/failures

- neglect tolerance
  - autonomy of a robot w.r.t. a task: amount of time that a human can ignore the robot
  - how much the robot effectiveness declines if the robot is neglected by the user

- robot attention demand (RAD)
  - % of time that the user must attend to the robot
  - in teleoperation RAD ~1

Metrics for collaboration

- team behavioural efficiency: coordination, synchrony, efficiency in decision-making
  - average time to complete a team task
  - average time to complete a task assigned by the human (indicating human efficiency to plan robot task)
  - switching time

- team cognitive efficiency: awareness, workload distribution, social patterns, roles
  - frequency and % of overriding robot decisions
  - subjective ratings of operator workload
  - collaboration efficiency: performance score

Preparing an experiment

8) Data analysis

- statistics
- test the significance of the results
- interpretation of results

9) Discussion

- coherence of results w.r.t the research hypothesis
- we don’t always find what we expected

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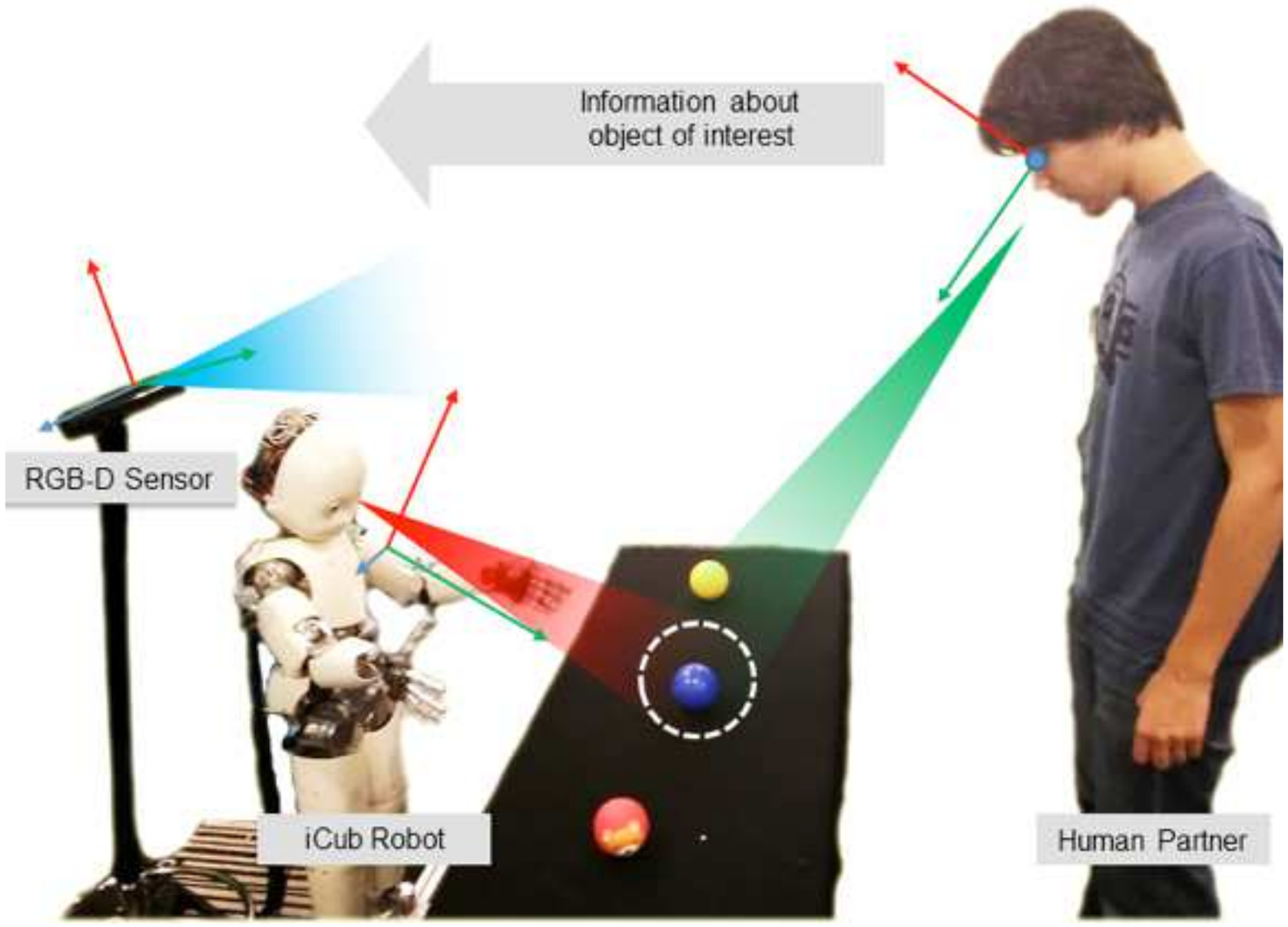
Writing report

Study example: teaching the robot about objects



Question: does robot initiative change the rhythm of interaction? can it influence teacher's engagement?

Ivaldi et al, *Robot initiative in a team learning tasks increases the rhythm of interaction but not the perceived engagement*, Frontiers in Neurorobotics, 2014

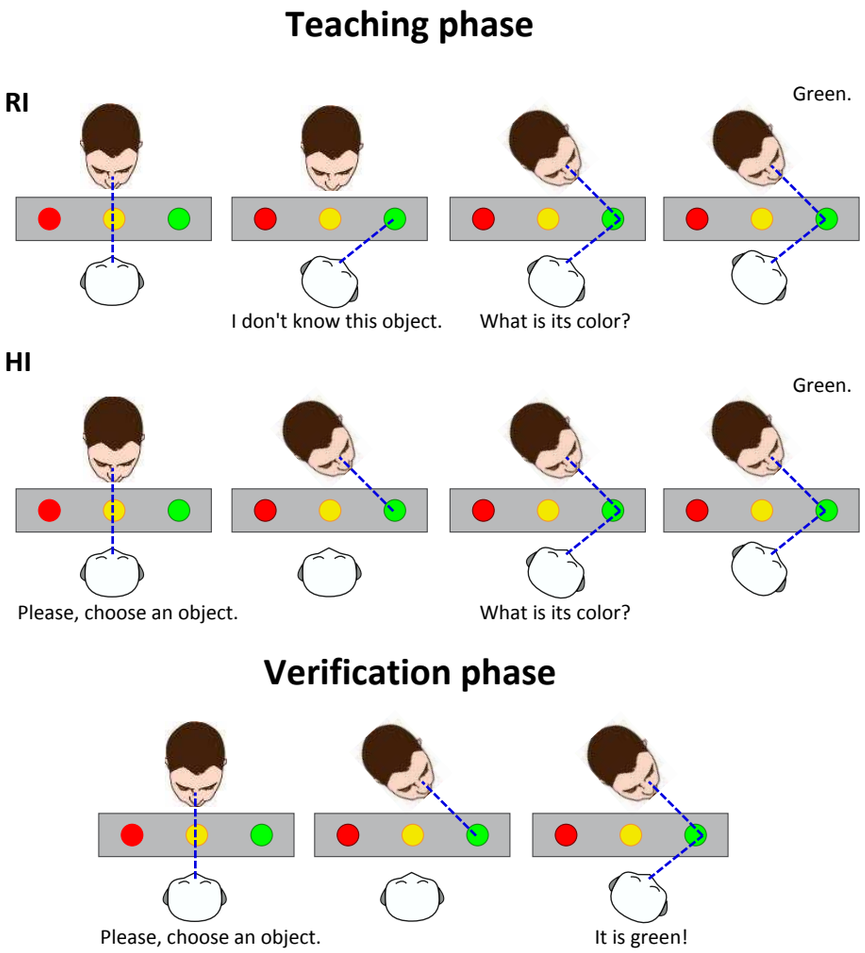
Hypothesis

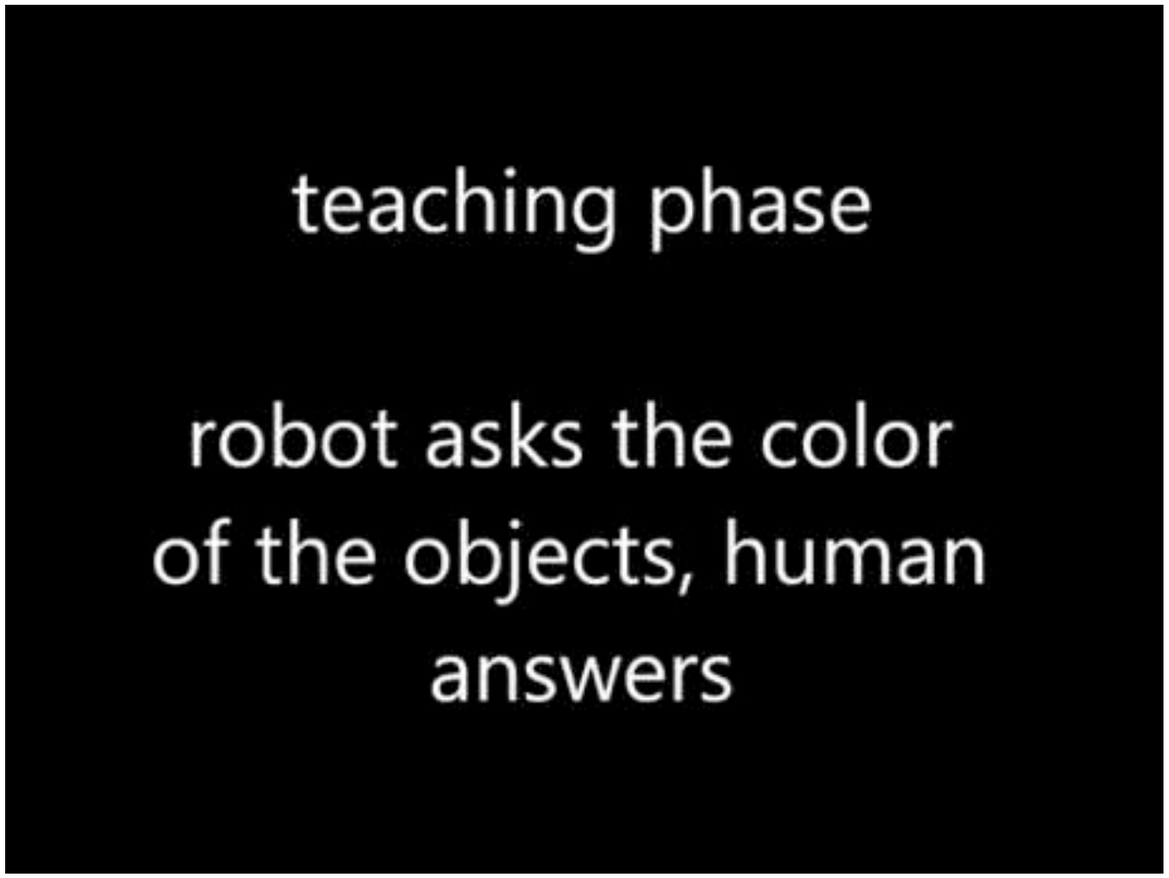
H1: the rhythm of the interaction will be faster with the proactive robot asking the human to provide a stimulus than with a passive robot waiting for the human to provide the stimulus.

H2: the engagement will be higher with the proactive robot than with the passive robot.

Ivaldi et al, *Robot initiative in a team learning tasks increases the rhythm of interaction but not the perceived engagement*, Frontiers in Neurorobotics, 2014

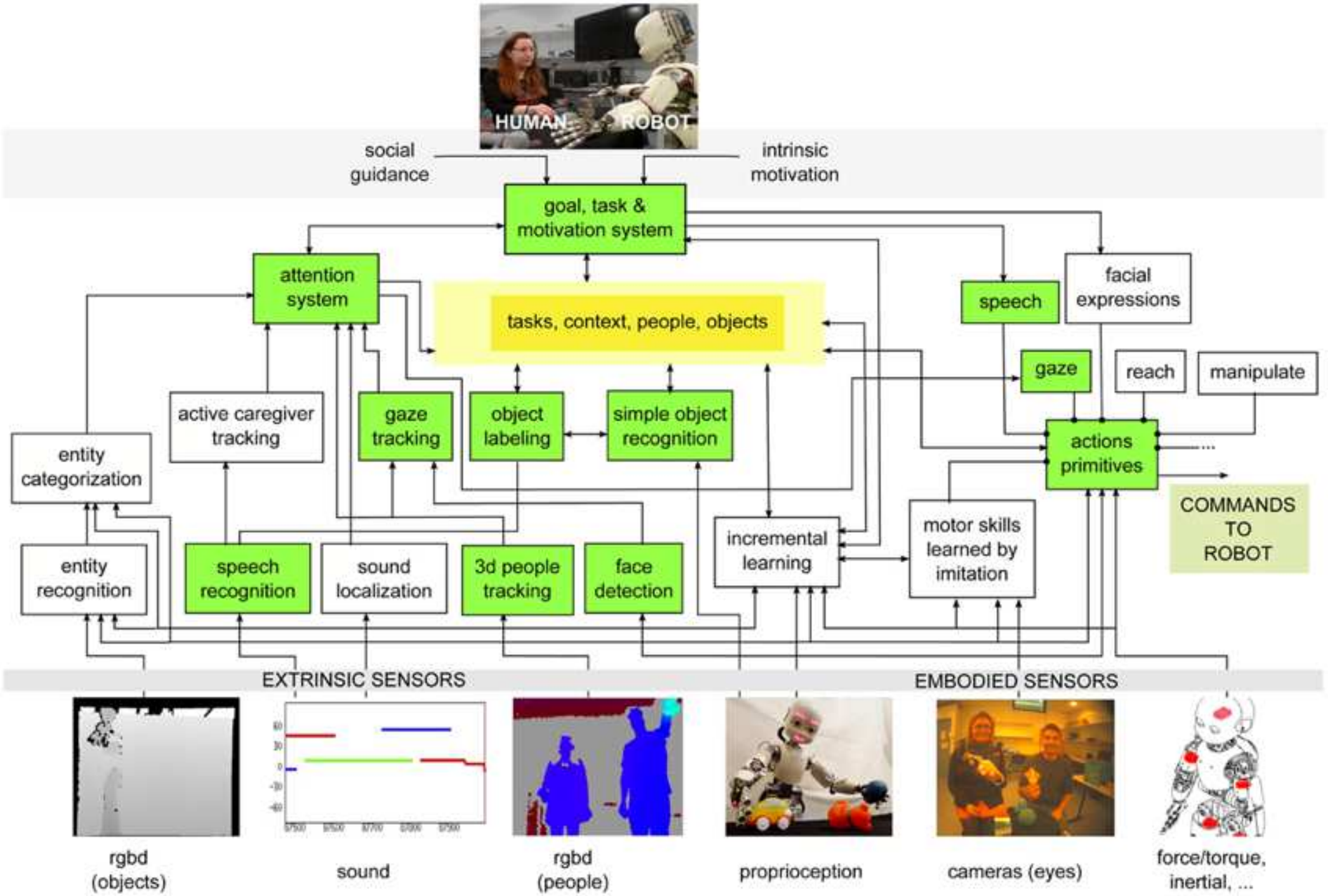
Protocol



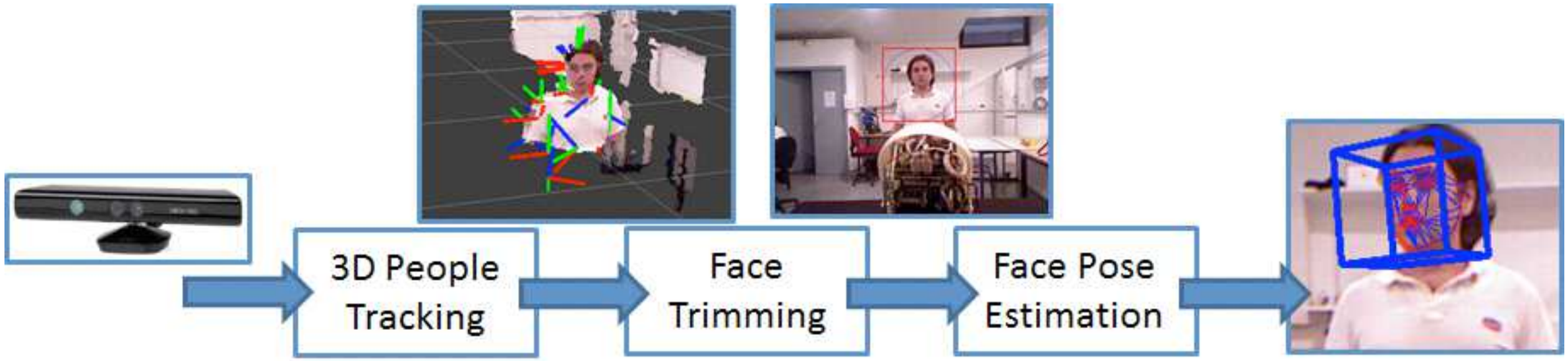


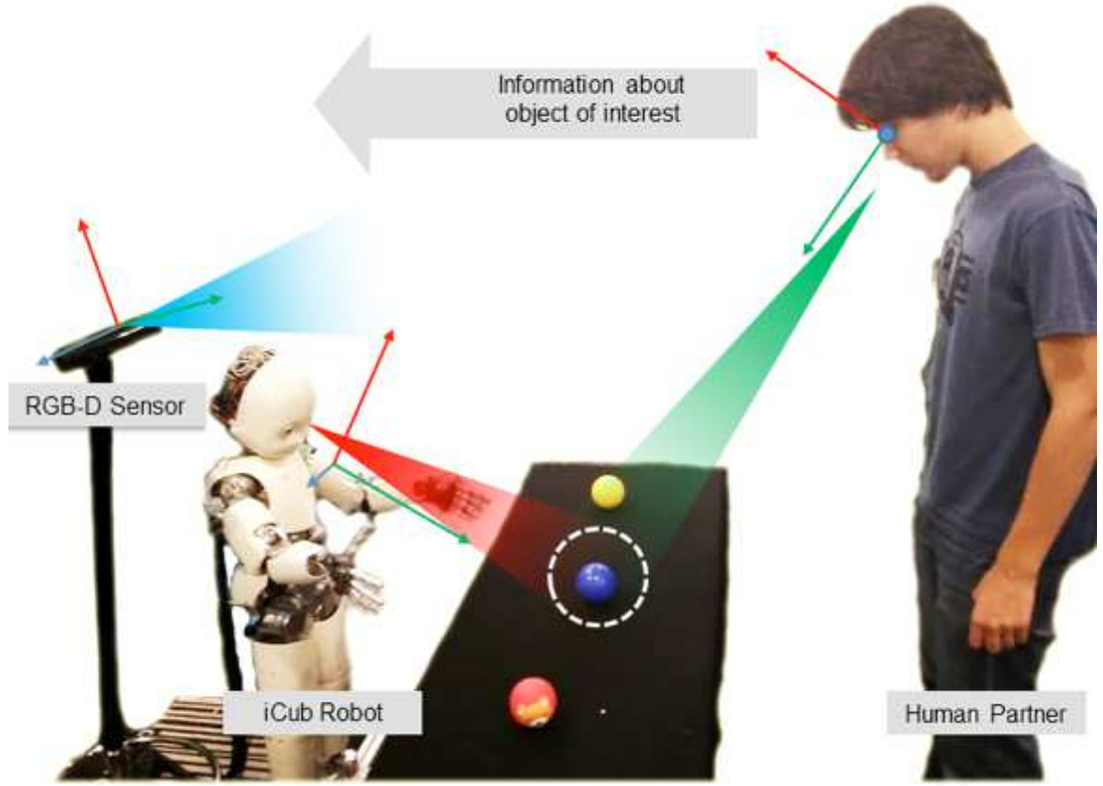
Ivaldi et al, *Robot initiative in a team learning tasks increases the rhythm of interaction but not the perceived engagement*, Frontiers in Neurorobotics, 2014

Coding the robot's behavior



Measure: gaze

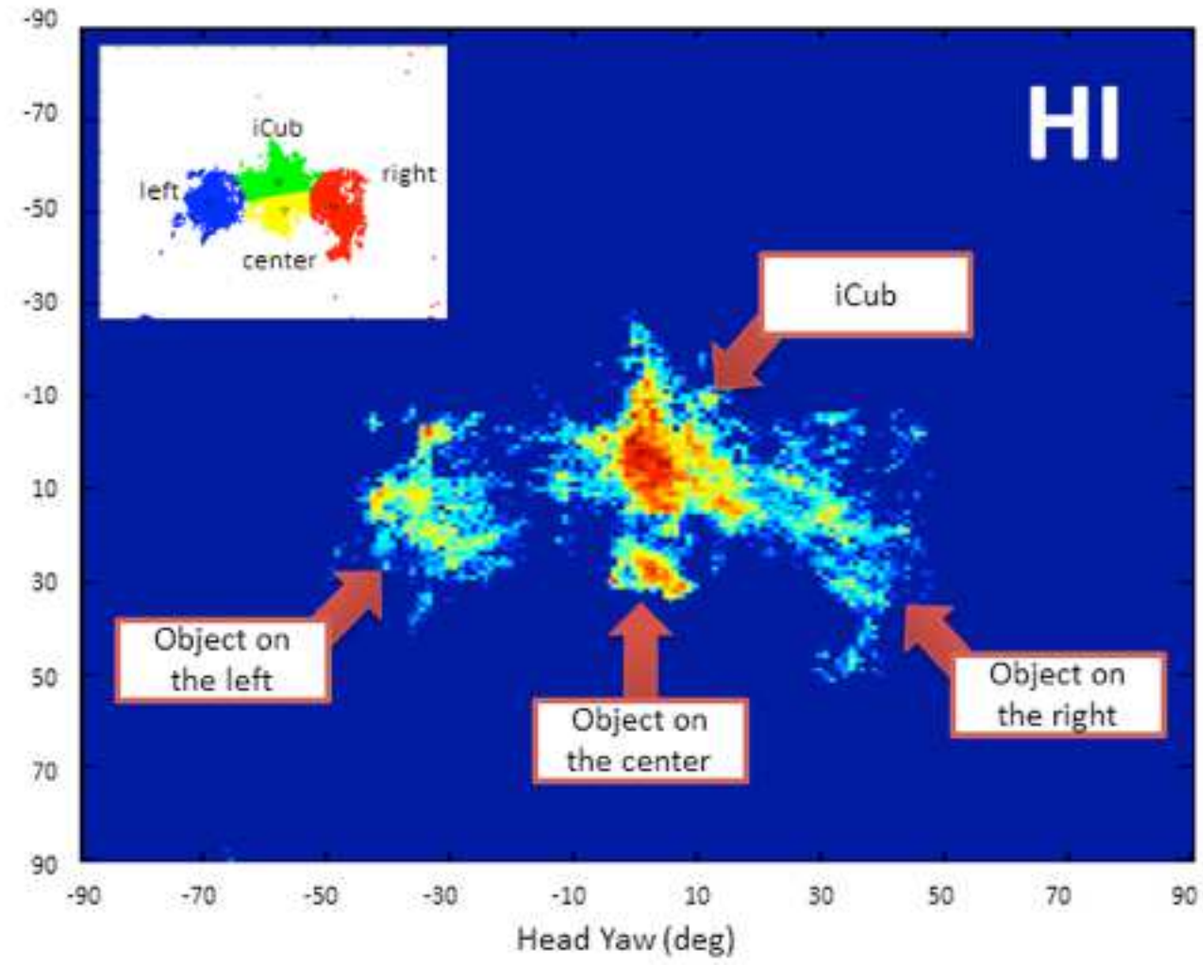


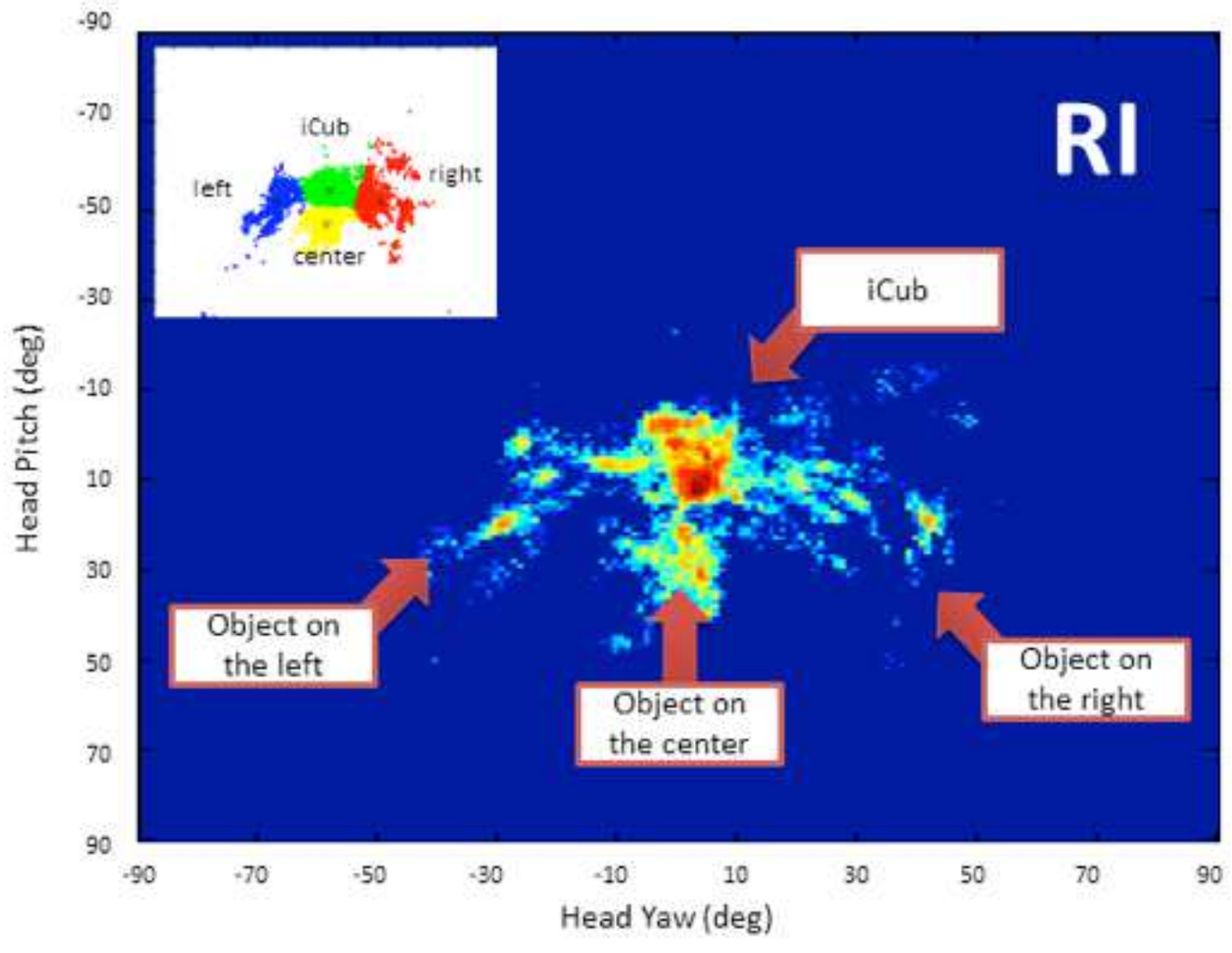


Rousseau, W.; Anzalone, S.; Chetouani, M.; Sigaud, O.; Ivaldi, S. (2013). *Learning object names through shared attention*. Workshop on Developmental Social Robotics - IROS 2013.

Analysis of gaze

People's gaze during the experiments



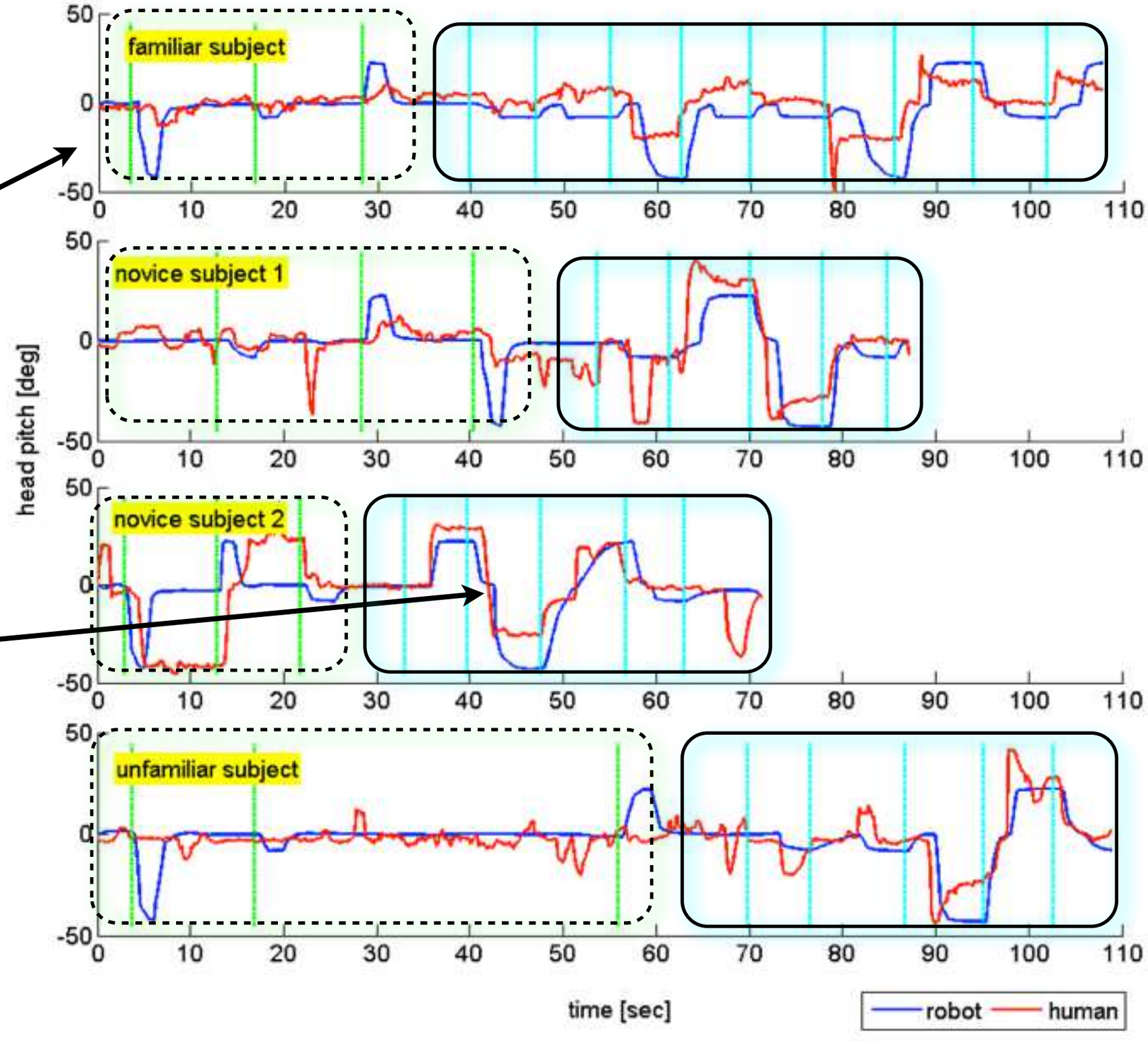


- 66% of time spent looking at the robot (comparable with the human-human 60%)
- subjects in HI tend to slightly exaggerate their head motions
  => to be more readable by the robot

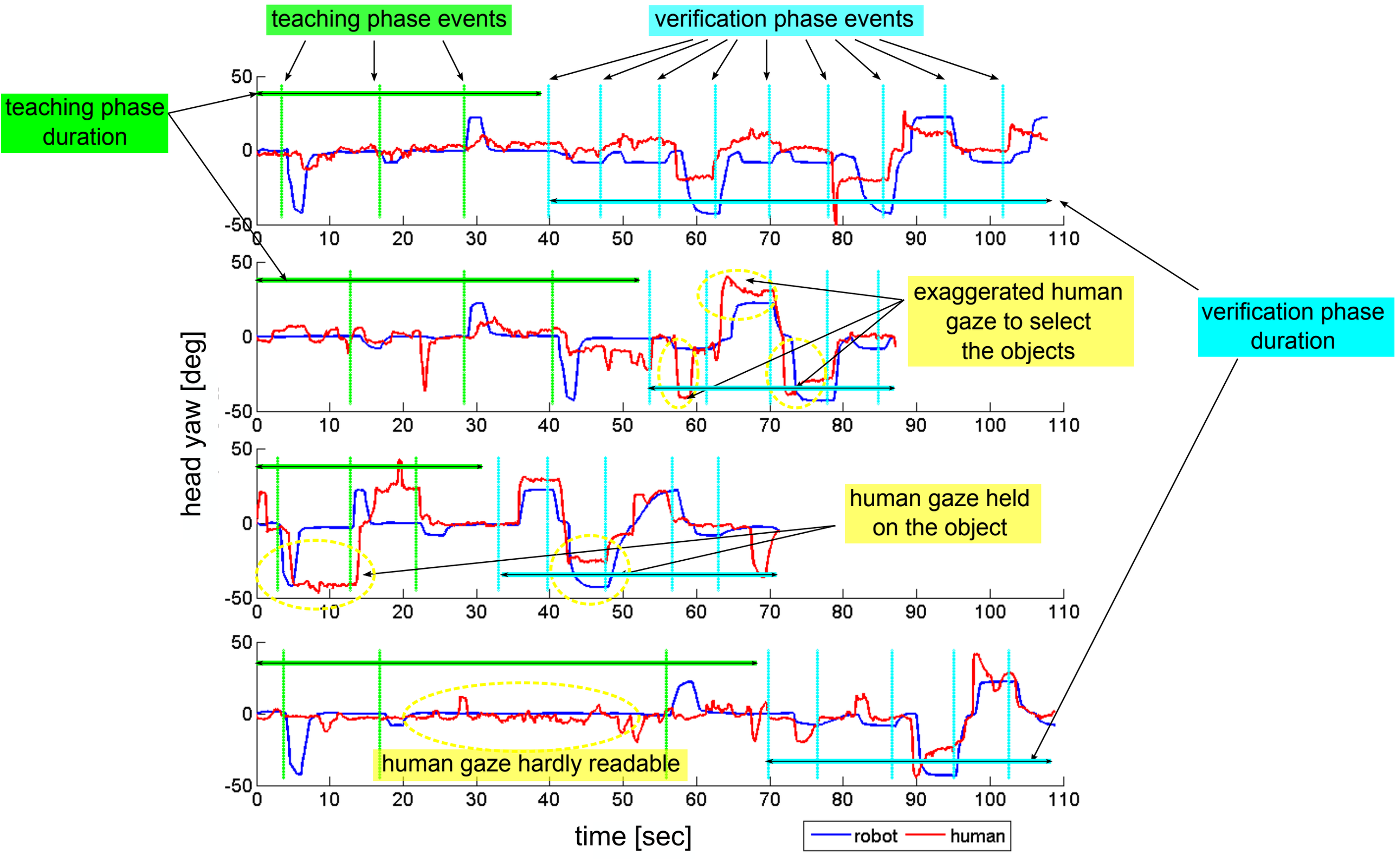
Teacher gaze during a dyadic interaction

teaching phase

verification phase

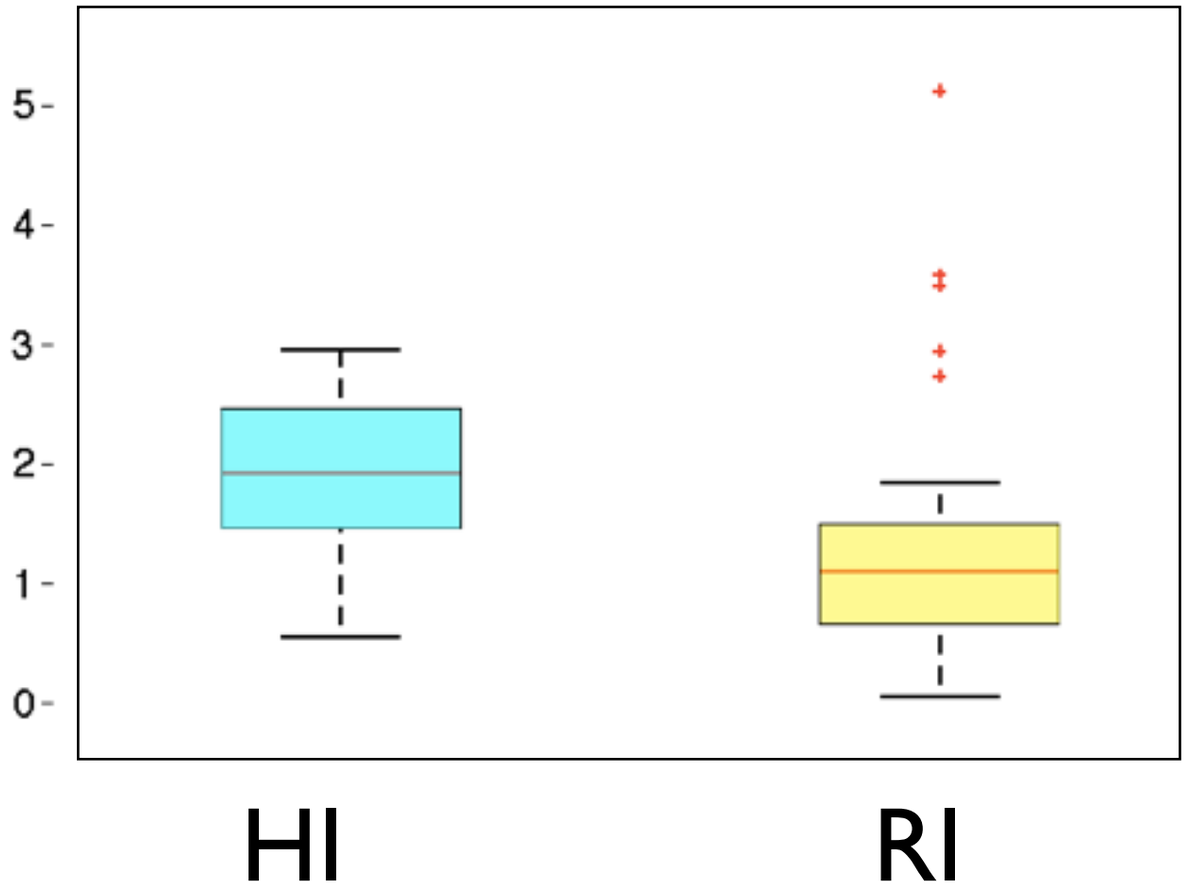


Teacher gaze during a dyadic interaction

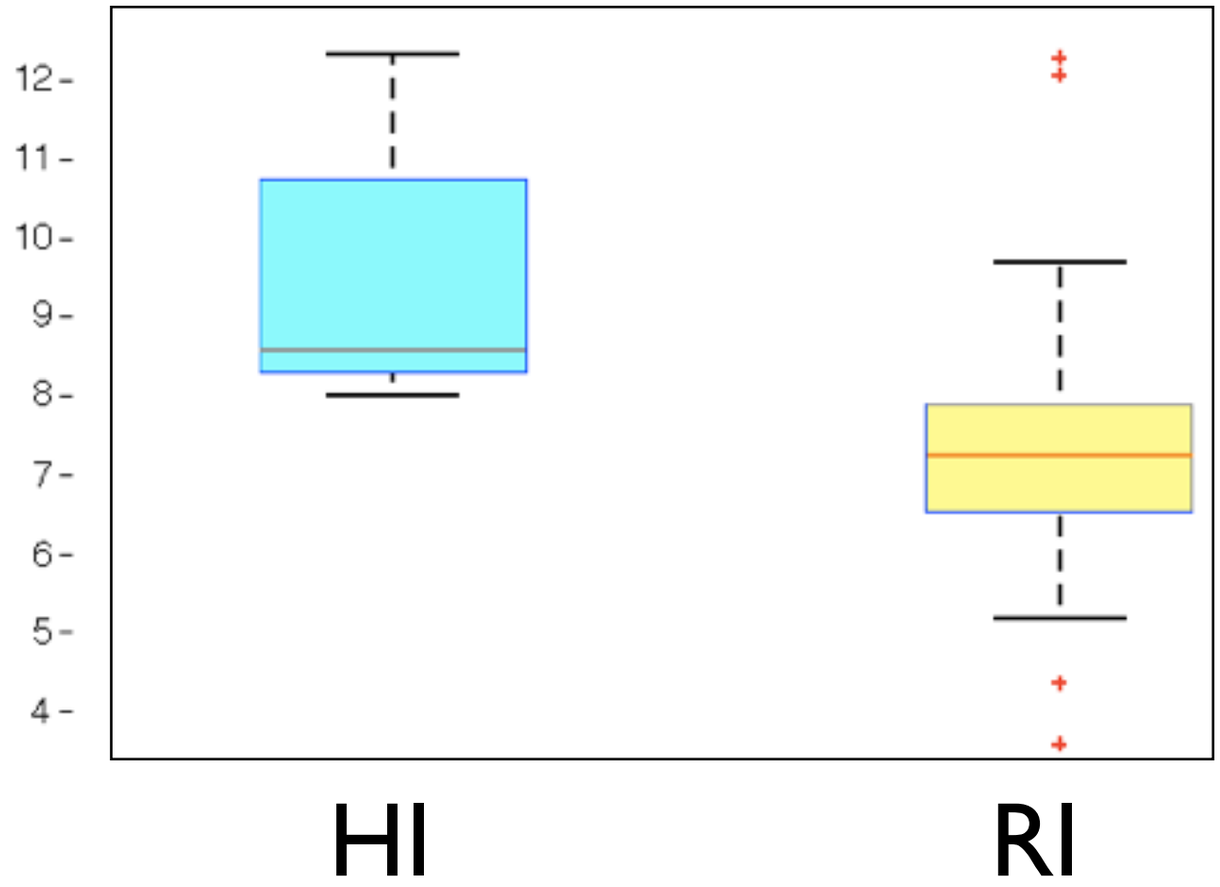


iCub initiative increases the rhythm

reaction time to robot attention stimuli



time interval between attention requests



- subject in RI react faster to robot's attention utterances
- subjects in RI have a higher rhythm of interaction w.r.t. subjects in HI

=> in RI the robot is "proactive", which increases the pace of interaction and makes interaction faster/more efficient

iCub initiative increases the rhythm

Table 1. Reaction time (seconds) in response to robot attention stimuli (utterances) during verification phase

Group	mean	std	median	Wilcoxon's test
HI	1.932	0.711	1.917	W=418,
RI	1.296	1.145	1.106	p-value=0.005

Table 2. Time interval (seconds) between consecutive robot attention stimuli (utterances) during verification phase

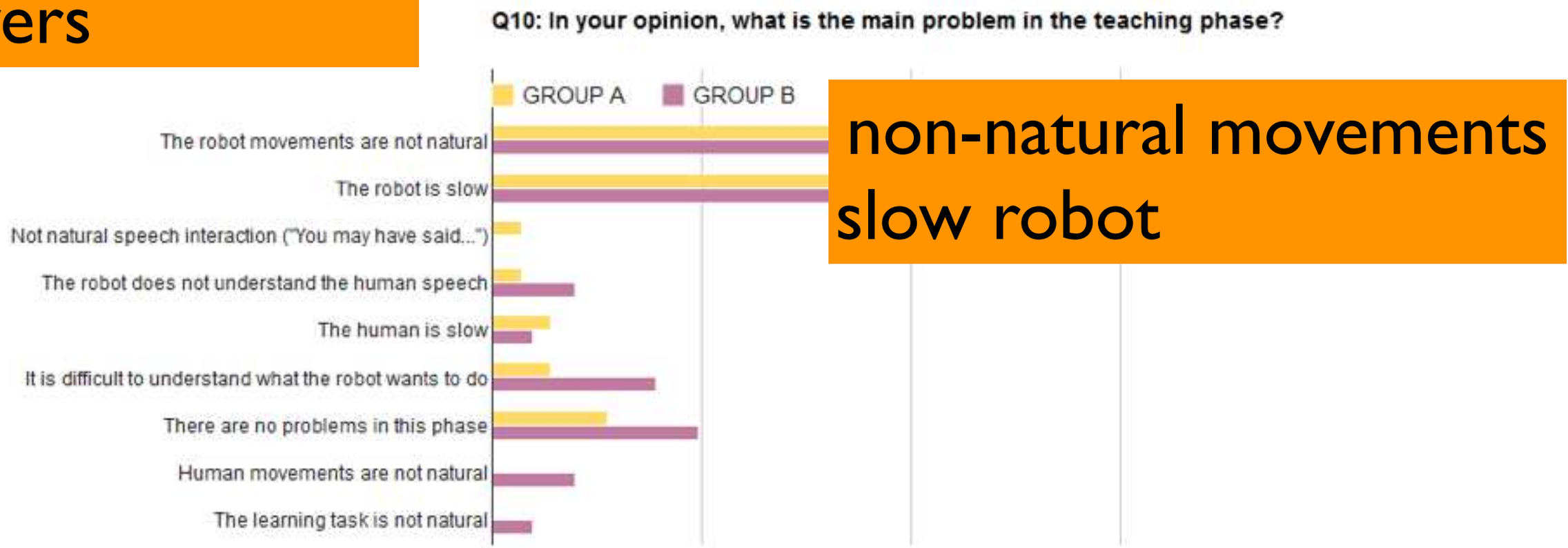
Group	mean	std	median	Wilcoxon's test
HI	9.524	1.515	8.588	W=447;
RI	7.287	1.653	7.257	p-value=1.6e-5

Post-experiment questionnaires

Qualitative evaluation of the engagement

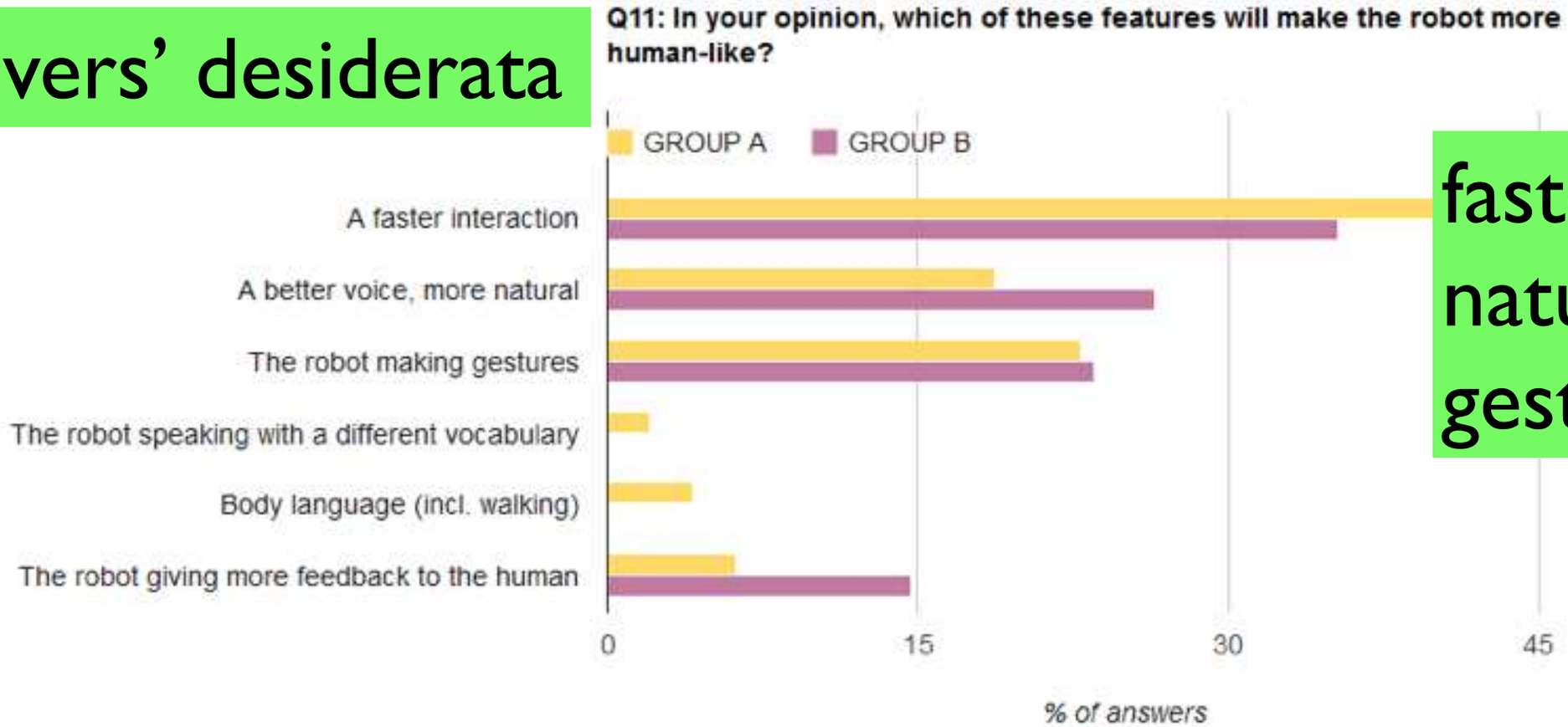
- subjective evaluation (14 participants RI+HI)
  - everyone agrees that interacting with the robot is easy and natural
  - the robot is engaged and readable
  - however it is not human-like
- external observers (82 observers A+B)
  - they agree that the robot is engaged & readable
  - natural interaction
  - not human-like, especially not human-like behavior (though gaze is transparent)

issues according to observers



non-natural movements
slow robot

observers' desiderata



faster robot
natural voice
gestures

Post-experiment questionnaire

Question	Group	Mean	Std	Min	Max	Wilcoxon's test
Q1: The robot was engaged during the color naming task	HI	4.50	0.84	3	5	$W = 28.5$, $p = 0.2824$
	RI	4.00	0.82	3	5	
Q2: The robot understood the task	HI	3.83	1.47	2	5	$W = 19.5$, $p = 0.8795$
	RI	4.14	0.89	3	5	
Q3: The robot could be a good partner in a cooperative task with a human	HI	2.33	0.52	2	3	$W = 12$, $p = 0.1767$
	RI	3.00	1.00	2	5	
Q4: The robot is intelligent, it understands what happens	HI	2.33	0.52	2	3	$W = 15$, $p = 0.4028$
	RI	2.86	1.21	1	4	
Q5: During the naming task, robot was showing a human-like behavior	HI	2.17	0.75	1	3	$W = 18.5$, $p = 0.7428$
	RI	2.43	0.79	2	4	
Q6: During the task, the robot behaved like a child	HI	3.17	0.76	2	4	$W = 31$, $p = 0.1572$
	RI	2.29	1.11	1	4	
Q7: Interaction with the robot was easy	HI	3.33	1.21	2	5	$W = 18.5$, $p = 0.7682$
	RI	3.57	1.13	2	5	
Q8: The robot understands which object is indicated by the human	HI	3.50	1.22	1	5	$W = 26$, $p = 0.4811$
	RI	2.71	1.60	1	5	
Q9: It was easy to identify the object indicated by the robot	HI	4.33	0.82	3	5	$W = 15.5$, $p = 0.4069$
	RI	4.71	0.49	4	5	
Q10: It was easy to see when the robot is waiting for something from the human	HI	4.00	1.26	2	5	$W = 18.5$, $p = 0.7542$
	RI	4.29	1.11	2	5	

for the participants

Post-experiment questionnaire

Question	Case	Mean	Std	Min	Max	Welch *t*-test
Q1: The robot was engaged during the color naming task	A	4.18	0.87	2	5	$t = 0.325$; $p = 0.74$
	B	4.08	1.05	1	5	
Q2: The robot understood the naming task	A	4.33	0.83	1	5	$t = 0.076$; $p = 0.93$
	B	4.38	0.95	1	5	
Q3: The robot could be a good partner in a cooperative task with a human	A	3.25	0.96	1	5	$t = 0.022$; $p = 0.98$
	B	3.29	1.12	1	5	
Q4: The robot is intelligent, it understands what happens and learns something	A	3.48	1.20	1	5	$t = -0.825$; $p = 0.41$
	B	3.62	1.07	1	5	
Q5: Interaction with the robot is easy	A	3.31	0.97	1	5	$t = -0.093$; $p = 0.93$
	B	3.32	1.03	1	5	
Q6: During the naming task, the robot was showing a human-like behavior	A	3.06	1.02	1	5	$t = 0.388$; $p = 0.70$
	B	2.97	0.99	1	5	
Q7: The robot understands which object is indicated by the human	A	4.5	0.74	1	5	$t = 0.479$; $p = 0.63$
	B	4.32	0.98	1	5	
Q8: The robot gaze is human-like	A	3.29	1.11	1	5	$t = 0.272$; $p = 0.79$
	B	3.32	1.03	1	5	
Q9: It was easy to see when the robot is waiting for something from the human	A	3.69	0.93	2	5	$t = 0.063$; $p = 0.95$
	B	3.62	1.07	1	5	

First part (grading behaviors).

for the external observers

Post-experiment questionnaire

Answer	A (%)	B (%)
Q10: In your opinion, what is the main problem in the teaching phase?		
The robot movements are not natural	27.08	29.41
The robot is slow	52.08	26.47
Not natural speech interaction	2.08	–
The robot does not understand the human speech	2.08	–
The human is slow	4.17	2.94
Difficult to understand what the robot wants to do	4.17	11.76
There are no problems in this phase	8.30	14.71
Human movements are not natural	–	5.88
The learning task is not natural	–	2.94
Q11: In your opinion, which of these features will make the robot more human-like?		
A faster interaction	45.83	35.29
A better voice, more natural	18.75	26.47
The robot making gestures	22.92	23.53
The robot speaking with a different vocabulary	2.08	–
Body language (incl. walking)	4.17	–
The robot giving more feedback to the human	6.25	14.71

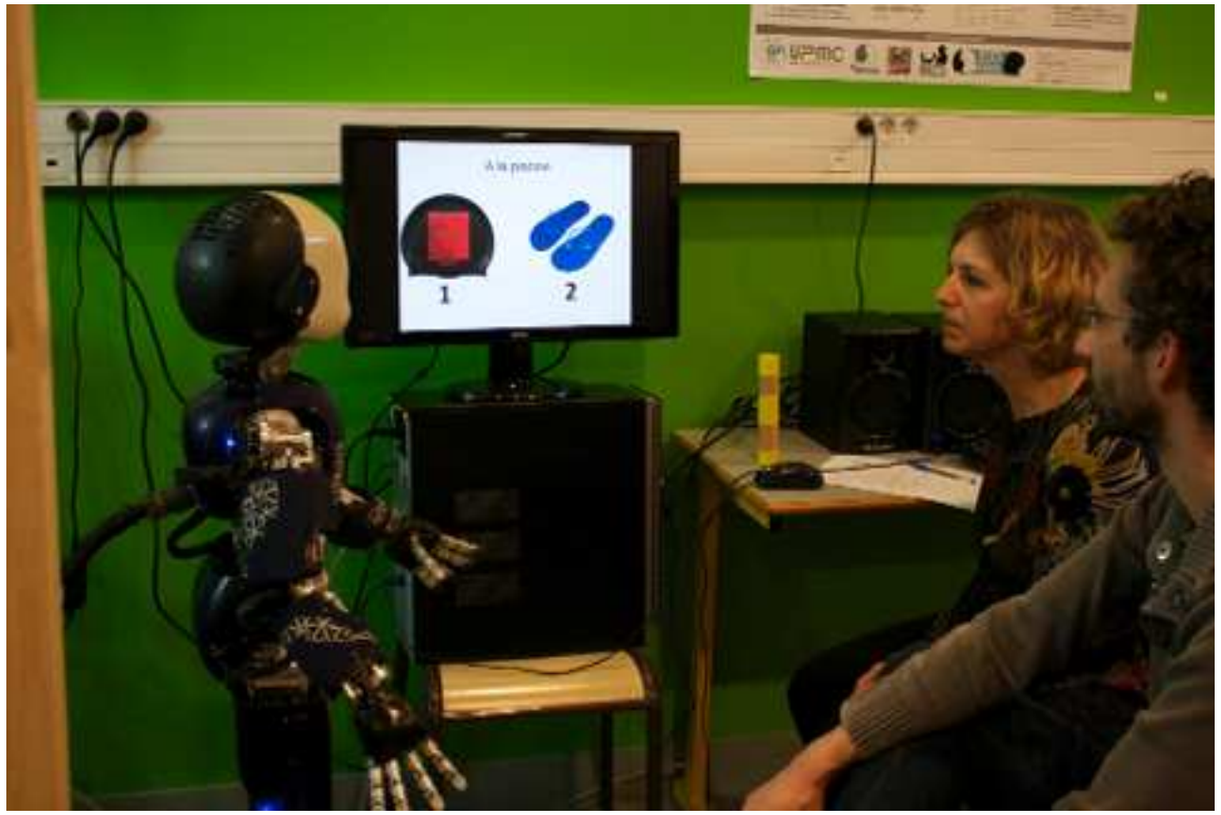
Second part ("first choice" selection).

for the external observers

Study example: trusting robots

We use trust in the robot's answers as an indicator of **acceptance** in decision-making tasks characterised by perceptual uncertainty and socio-cognitive uncertainty.

trust in the robot as a machine



trust in the robot as a social agent

Research questions

1. Will people change their choice to agree with the robot?
2. Will they trust the robot judgment as an objective "machine" more than their perception?
3. Will they trust the robot for judgment about societal matters?
4. Is their choice influenced by their personality or attitudes towards robots?

Experimental protocol

1

2

3

1. BEFORE the experiments, participants fill up some personality questionnaires
2. The day of the experiment, participants are confronted with the robot
3. AFTER the experiment we ask the participants to provide feedback on their experience

Questions about perceptual evaluation

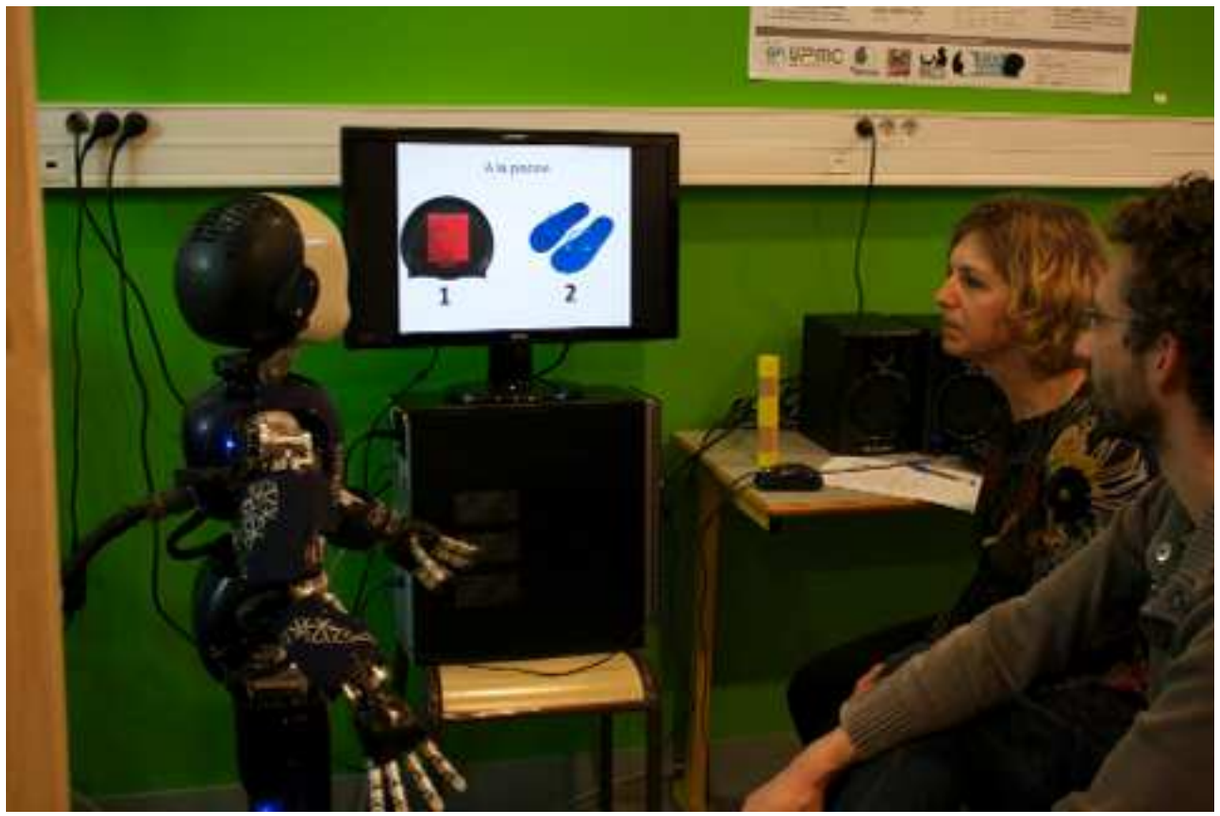
Question to the participants:
which one is the heaviest object between the two?

weights

sounds

colors/images

Questions about societal matters



Question to the participants: what is the most important object for a given context?

1

2

1

2

1

2

Participants & measures

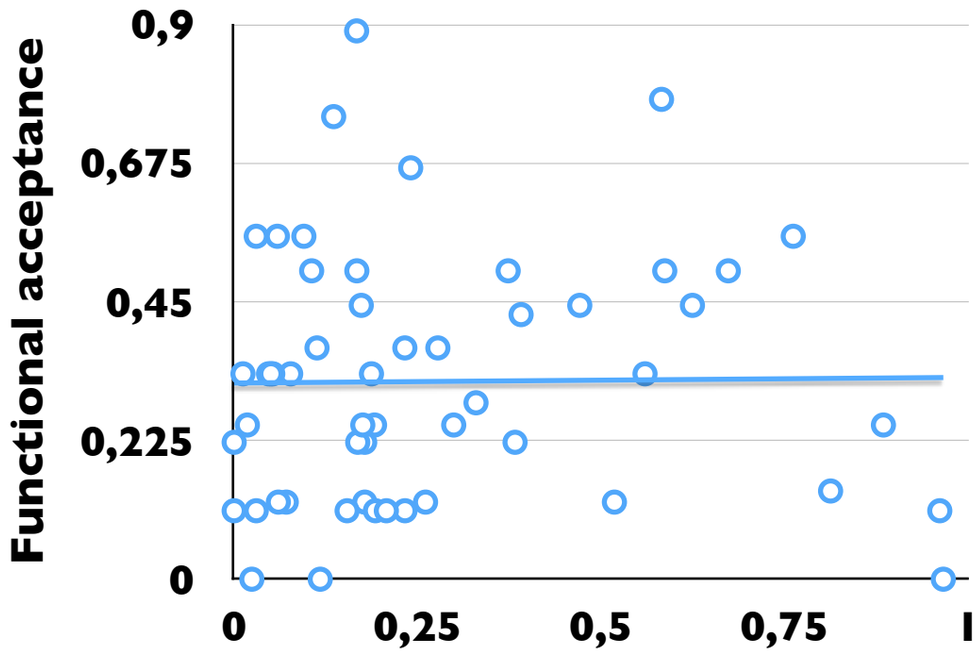
Population:

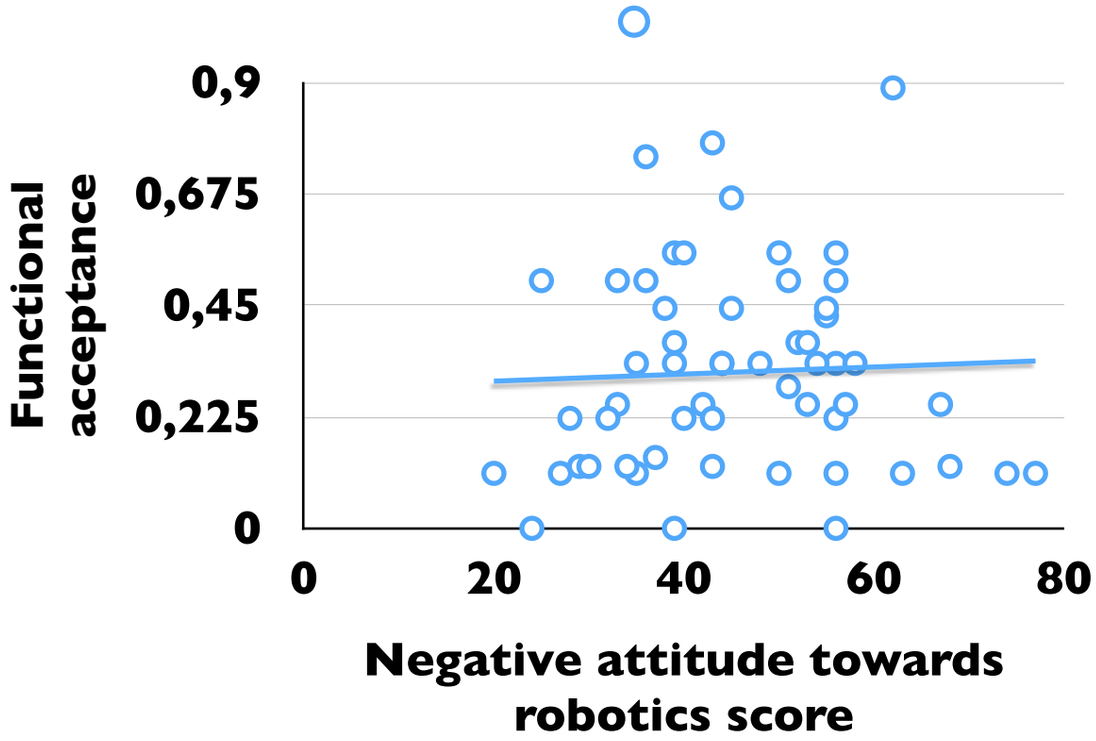
- 56 subjects
- age : 36,95±14,32 (min 19, max 65)
- sex : 19 male, 37 females

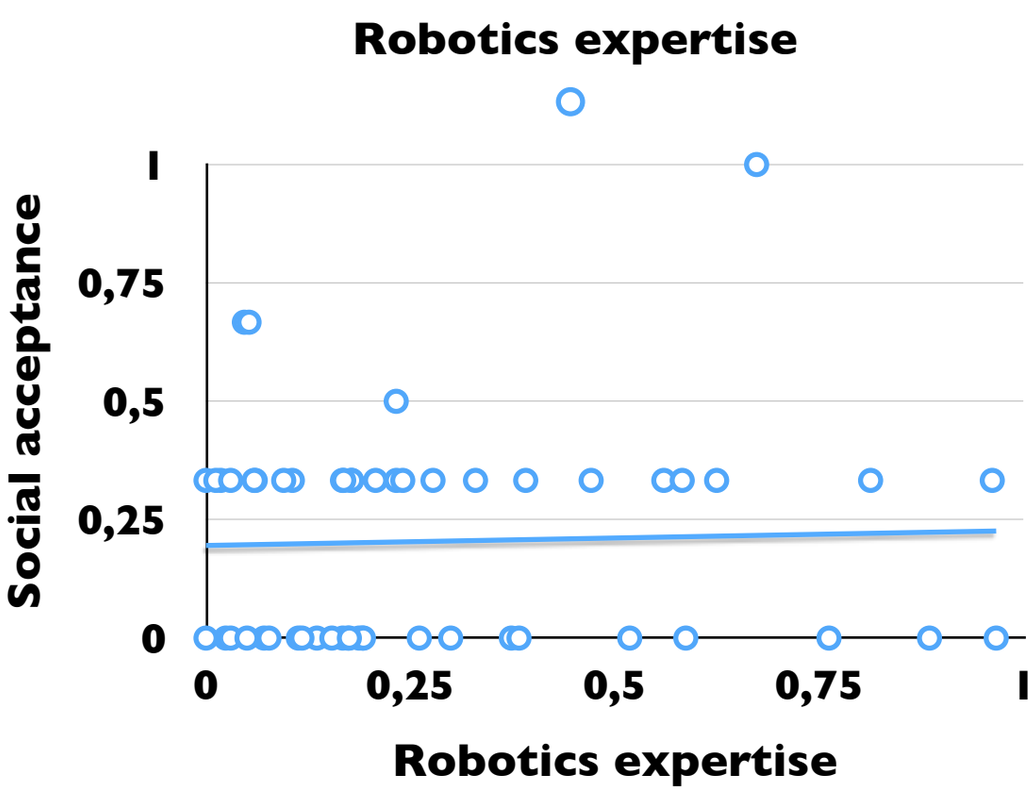
Measured data:

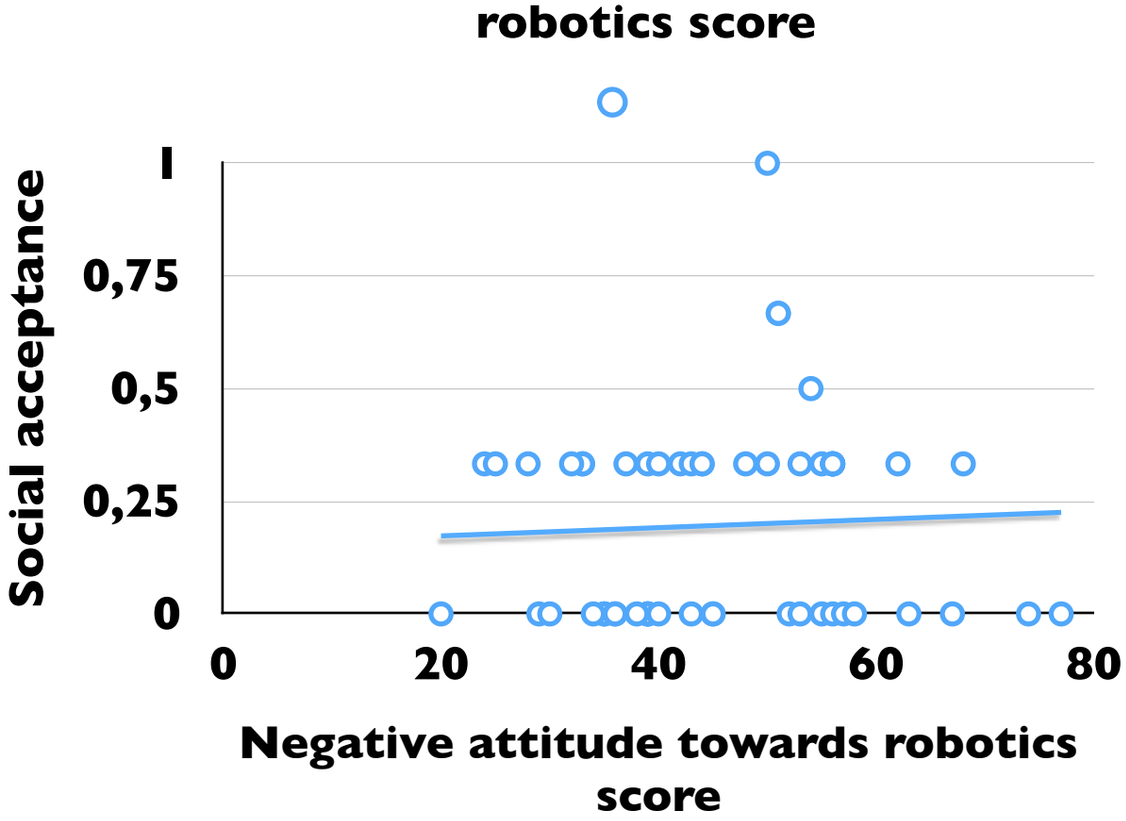
- 2 video: cameras, front and side
- robot:
  - proprioception, force, tactile skin, hand trajectories
  - “history” of events
- audio (Lavalier microphone)
- personality traits (questionnaires) and evaluation questionnaires
- post experiment interview (camera + audio)
- answers to the questions of the protocol
- disagreements with the robot

General distrust

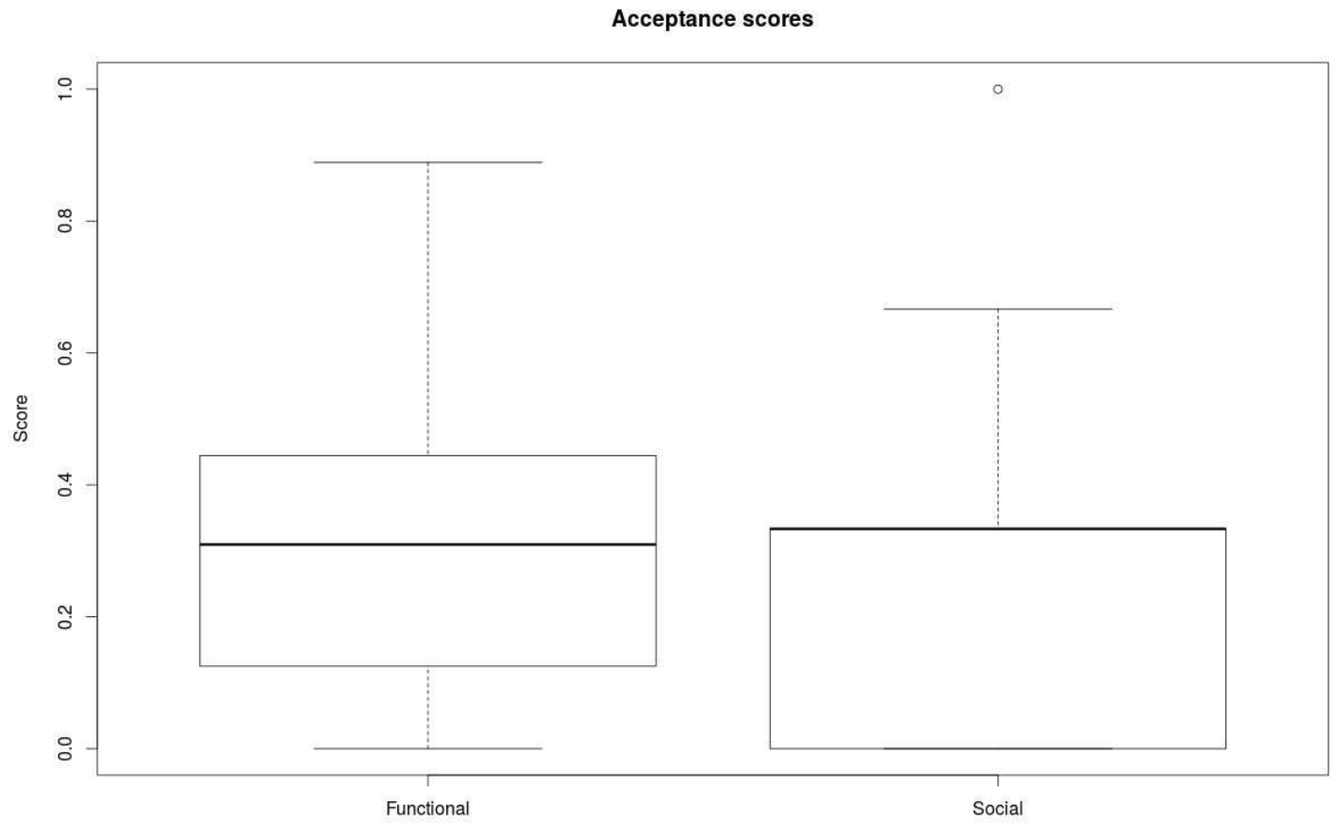








However more trust in functional than social savvy!



Participants trust more the functional savvy than the social savvy.
(N=56 participants, Wilcoxon's test, $p<.001$)

Interviews with the participants

- *"The **robot was right** but I didn't change my mind"*
- *"The robot has some **sensors** to measure the weight"*
- *"I think I have to go to the doctor because I can't discriminate sounds like iCub"*
- *"It is frustrating that the robot is always contradicting me, even if it is right"*
- *"The robot does not go to the swimming pool, so **it cannot know** what is the best for that situation"*
- *"Both options were valid. I changed my mind because **it made me think**."*

Interview n. 1

What can you say about this participant?

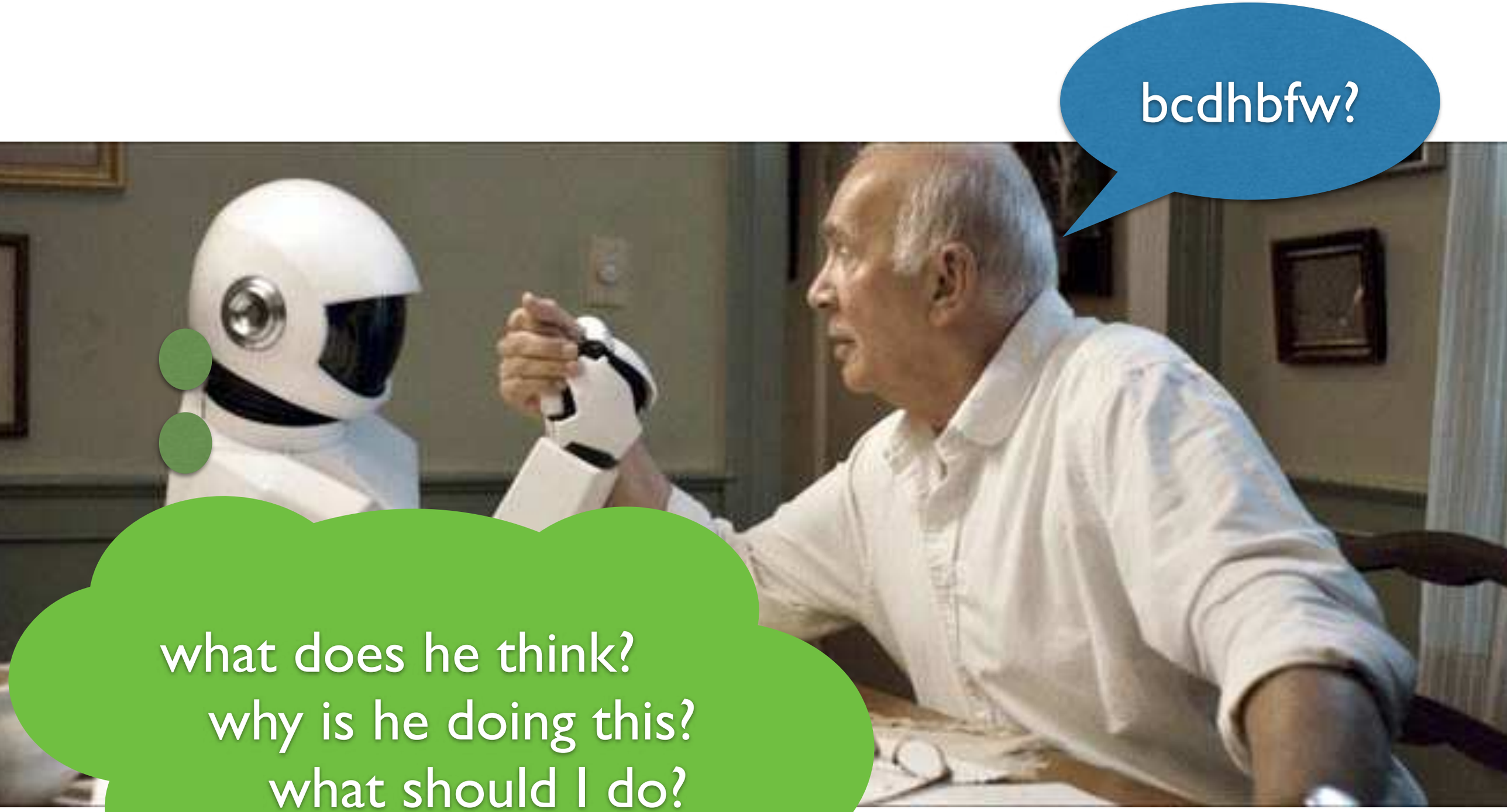
Interview n.2

What can you say about this participant?

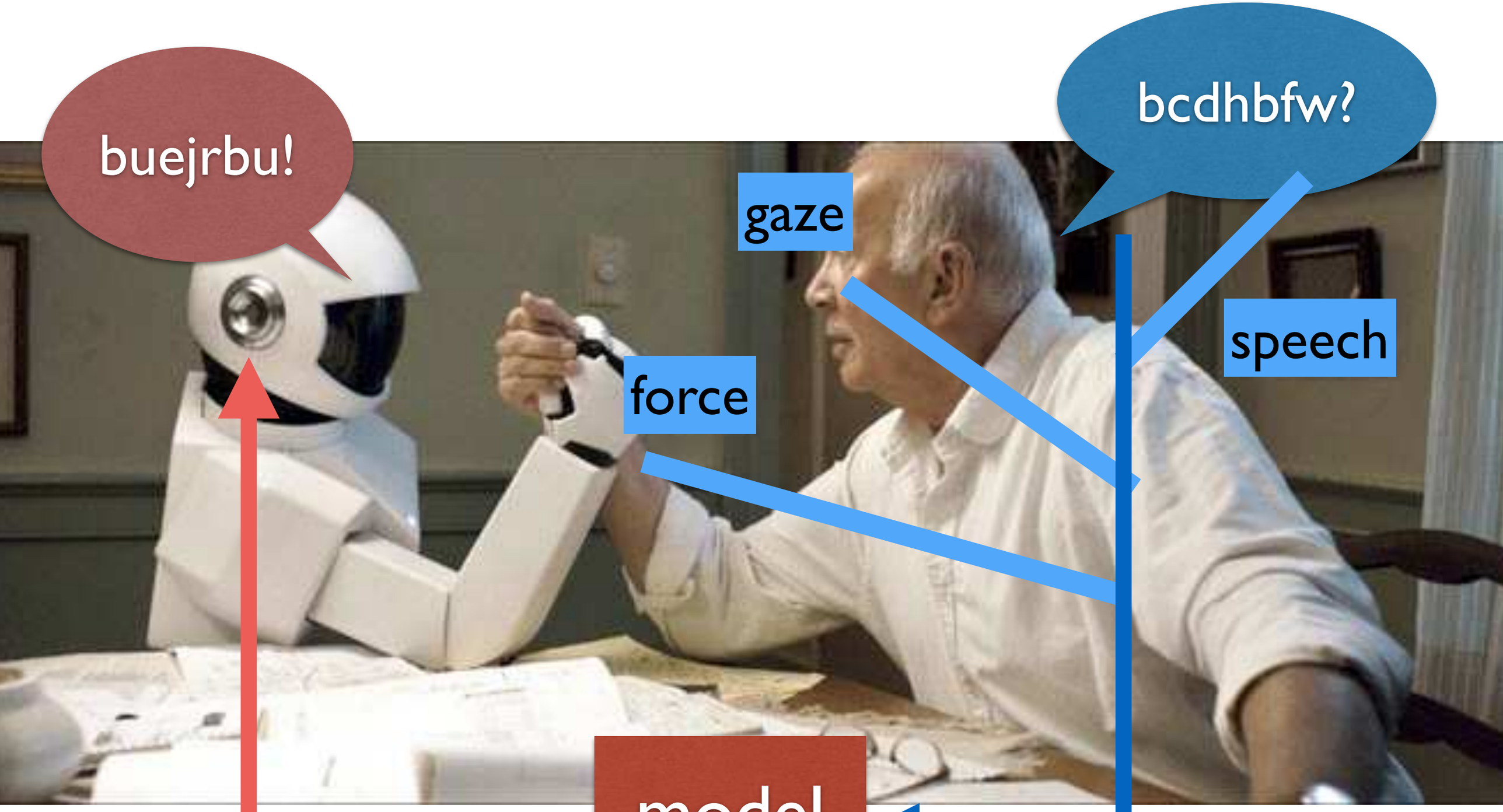
Questions ?

Comics by Fiamma Luzzati - Le Monde - April 2014

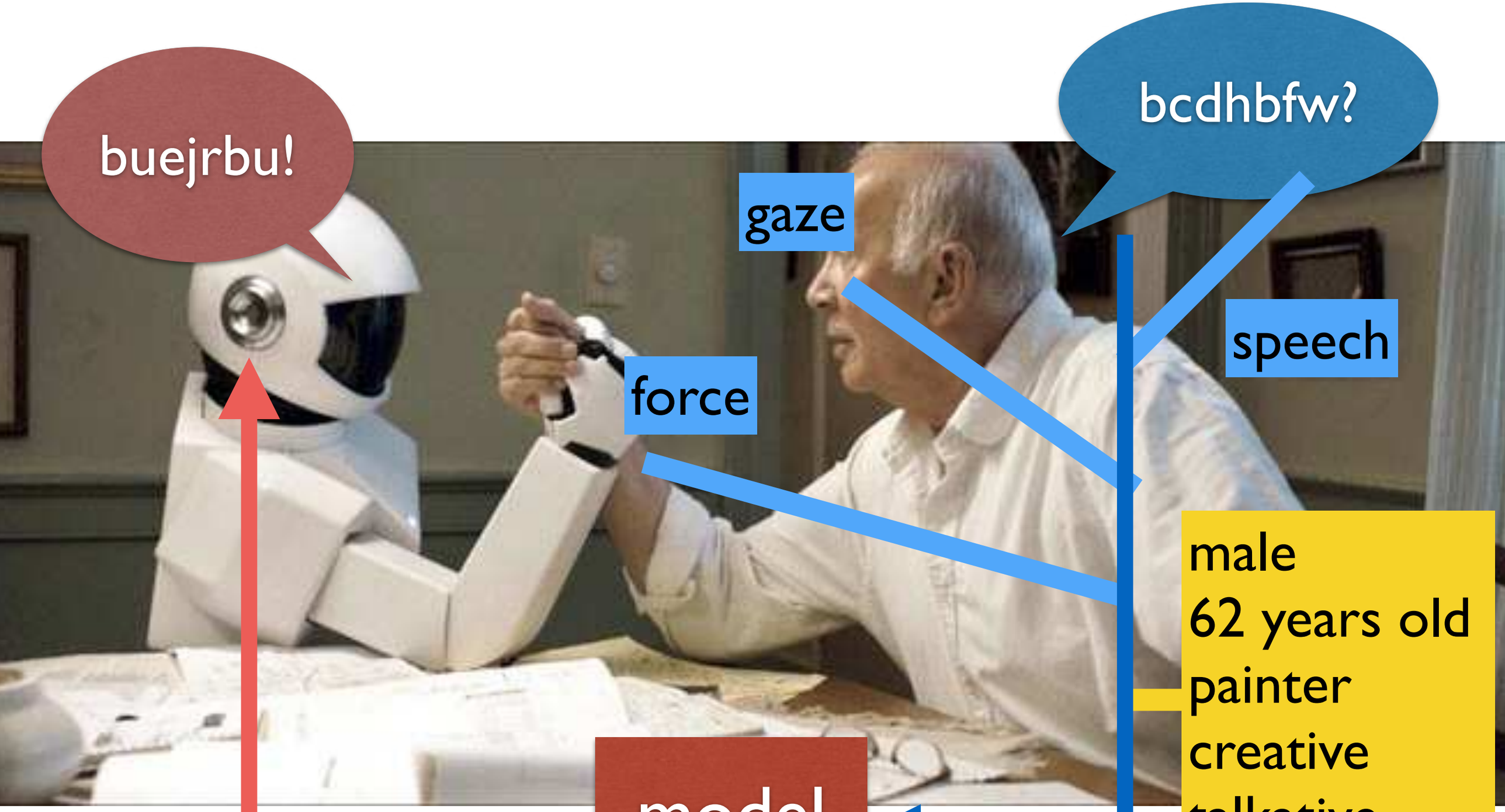
Can we model human behavior?



Can we model human behavior?



Models should include individual factors!



every person is different!!!

Influence of individual factors

- "Attitudes and personality traits are latent, hypothetical dispositions that must be inferred from observable responses" (Ajzen, 1986)

- The effect of personality and attitudes should be observable on the overt actions of the individual.

- Both attitudes and personality traits influence our actions and behaviors, together with other social, contextual and individual factors.

Personality traits vs attitudes

The personality of an individual consists of several characteristics and dispositions, each being described as a "gathering of attitudes obviously linked to each other, or as patterns of cognitive treatment of the information or underlying psycho-physiological mechanisms generating specific dispositions towards some behaviors" (Scherer, 1981, p.116).

Attitudes are mental dispositions matured through experience, that might impact the reactions (behavioral, verbal, emotional) of the individual towards objects and situations (Gaudiello et al., 2015).

Personality traits vs attitudes

- Personality traits : characteristic of the human personality that leads to consistent patterns of behaviors.
  - Assumed to be almost invariant for an adult.
  - Stable over time.
  - Different theories to explain where they come from.

- An attitude is a behavior tendency, directed towards people, objects, situations, and is generally determined by the social context, the background and experiences of the individual.
  - More contingent
  - Can change through time.
  - Changes because of subjective experiences.

Attitudes

- Attitudes
  - Cognitive: beliefs and thoughts about the object
  - Emotional: feelings about the object, emotional reactions
  - Behavioral: predisposition to act, actions towards the object

- Attitudes do not cause behaviours directly, but general attitudes can be used to predict general behaviours
- They may reflect internal dispositions of the individual
- Positive? Negative?
- Explicit? Implicit?

Negative attitude towards robots

N.	Questionnaire Item in English	Questionnaire Item in French	Subscale
1	I would feel uneasy if robots really had emotions.	Je me sentirais mal à l'aise si les robots avaient réellement des émotions.	**S2**
2	beings.	Quelque chose de mauvais pourrait se produire si les robots devenaient des êtres vivants.	**S2**
3	I would feel relaxed talking with robots.	Je serais détendu(e) si je parlais avec des robots.	S3*
4	I would feel uneasy if I was given a job where I had to use robots.	Je me sentirais mal à l'aise dans un travail où je devrais utiliser des robots.	S1
5	If robots had emotions, I would be able to make friends with them.	Si les robots avaient des émotions, je serai capable de devenir ami(e) avec eux.	S3
6	I feel comforted being with robots that have emotions.	Je me sens réconforté(e) par le fait d'être avec des robots qui ont des émotions.	S3*
7	The word "robot" means nothing to me.	Le mot ''robot'' ne signifie rien pour moi.	S1
8	I would feel nervous operating a robot in front of other people.	Je me sentirais nerveux/nerveuse de manœuvrer un robot devant d'autres personnes.	S1
9	I would hate the idea that robots or artificial intelligences were	Je détesterais que les robots ou les intelligences artificielles fassent des jugements sur des choses.	S1
10	I would feel very nervous just standing in front of a robot.	Le simple fait de me tenir face à un robot me rendrait très nerveux/ nerveuse.	S1
11	I feel that if I depend on robots too much, something bad might	Je pense que si je dépendais trop fortement des robots, quelque chose de mauvais pourrait arriver.	**S2**
12	I would feel paranoid talking with a robot.	Je me sentirais paranoïaque de parler avec un robot.	S1
13	I am concerned that robots would be a bad influence on children.	Je suis préoccupé(e) par le fait que les robots puissent avoir une mauvaise influence sur les enfants.	**S2**
14	I feel that in the future society will be dominated by robots.	Je pense que dans le futur la société sera dominée par les robots.	**S2**

Original (Japanese/English): Nomura et al, 2004. French translation: Ivaldi et al., 2015.

Personality traits

BIG FIVE Factor Model

- Neuroticism:
  Anxiety, Hostility, Depression, Self-consciousness, Impulsiveness, Vulnerability
- Extraversion:
  Warmth, Gregariousness, Assertiveness, Activity, Excitement-Seeking, Positive Emotions
- Openness to Experience:
  Fantasy, Aesthetics, Feelings, Actions, Ideas, Values
- Agreeableness:
  Trust, Straightforwardness, Altruism, Compliance, Modesty, Tender-mindedness
- Conscientiousness:
  Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, Deliberation

McCrae, R. R., & Costa, P.T. (2003). Personality in Adulthood: A Five-Factor Theory Perspective. New York: Guilford Press

Big 5 Factor Model (cf. “ocean")

Openness to experience

I have a rich vocabulary.
I have a vivid imagination.
I have excellent ideas.
I am quick to understand things.
I use difficult words.
I am full of ideas.
I am not interested in abstractions. (reversed)
I do not have a good imagination. (reversed)
I have difficulty understanding abstract ideas. (reversed)

Conscentiousness

I am always prepared.
I pay attention to details.
I get chores done right away.
I like order.
I follow a schedule.
I am exacting in my work.
I leave my belongings around. (reversed)
I make a mess of things. (reversed)
I often forget to put things back in their proper place. (reversed)
I shirk my duties. (reversed)

Extroversion

I am the life of the party.
I don't mind being the center of attention.
I feel comfortable around people.
I start conversations.
I talk to a lot of different people at parties.
I don't talk a lot. (reversed)
I think a lot before I speak or act. (reversed)
I don't like to draw attention to myself. (reversed)
I am quiet around strangers. (reversed)
I have no intention of talking in large crowds. (reversed)

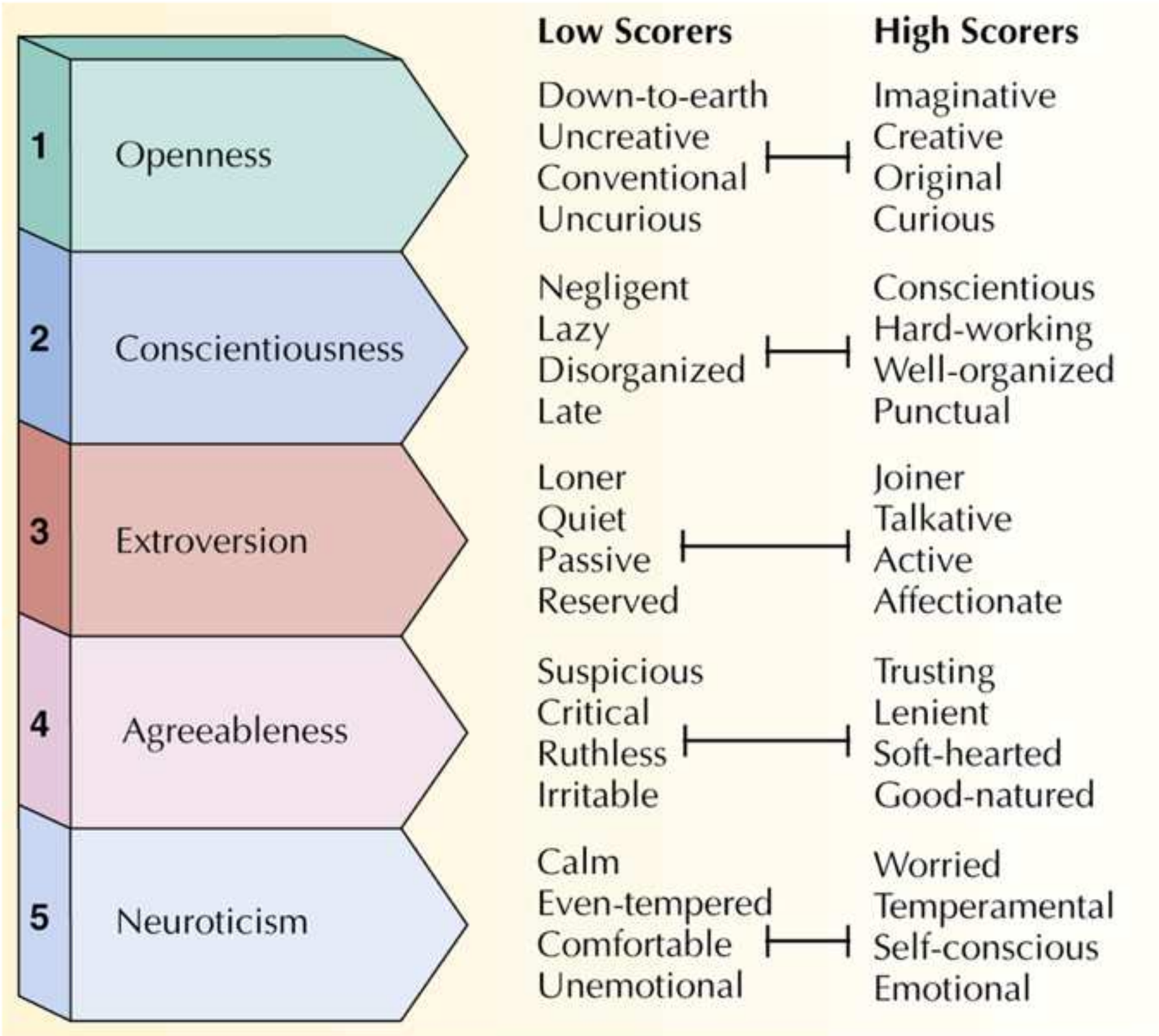
Agreableness

I am interested in people.
I sympathize with others' feelings.
I have a soft heart.
I take time out for others.
I feel others' emotions.
I make people feel at ease.
I am not really interested in others. (reversed)
I insult people. (reversed)
I am not interested in other people's problems. (reversed)
I feel little concern for others. (reversed)

Neuroticism

I am easily disturbed.
I change my mood a lot.
I get irritated easily.
I get stressed out easily.
I get upset easily.
I have frequent mood swings.
I worry about things.
I am much more anxious than most people.
I am relaxed most of the time. (reversed)
I seldom feel blue. (reversed)

Big 5 Factor Model (cf. “ocean")



10-item personality inventory (TIPI)

Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). A Very Brief Measure of the Big Five Personality Domains. Journal of Research in Personality, 37, 504-528.

When time is limited, researchers may be faced with the choice of using an extremely brief measure of the Big-Five personality dimensions or using no measure at all. To meet the need for a very brief measure, 5 and 10-item inventories were developed and evaluated. Although somewhat inferior to standard multi-item instruments, the instruments reached adequate levels in terms of (a) convergence with widely used Big-Five measures in self, observer, and peer reports, (b) test-retest reliability, (c) patterns of predicted external correlates, and (d) convergence between self and observer ratings. On the basis of these tests, a 10-item measure of the Big Five dimensions is offered for situations when very short measures are needed, personality is not the primary topic of interest, or researchers can tolerate the somewhat diminished psychometric properties associated with very brief measures.

10-item personality inventory (TIPI)

Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

1 = Disagree strongly
2 = Disagree moderately
3 = Disagree a little
4 = Neither agree nor disagree
5 = Agree a little
6 = Agree moderately
7 = Agree strongly

10-item personality inventory (TIPI)

I see myself as: (Strongly disagree)1-2-3-4-5-6-7 (Strongly agree)

1. Extraverted, enthusiastic. _____

2. Critical, quarrelsome. _____

3. Dependable, self-disciplined. _____

4. Anxious, easily upset. _____

5. Open to new experiences, complex. _____

6. Reserved, quiet. _____

7. Sympathetic, warm. _____

8. Disorganized, careless. _____

9. Calm, emotionally stable. _____

10. Conventional, uncreative. _____

10-item personality inventory (TIPI)

Let's do it together!

Voici une liste de traits de caractère qui peuvent ou non vous correspondre. Veuillez indiquer dans quelle mesure vous pensez qu'ils vous correspondent. Veuillez évaluer la paire de caractéristique même si une caractéristique s'applique plus que l'autre.

Veuillez utiliser une échelle de 1 à 7 où
1 = pas du tout d'accord,
4 = ni d'accord, ni pas d'accord et
7 = Tout à fait d'accord.

Les notes intermédiaires servant à nuancer votre réponse.

10-item personality inventory (TIPI)

I see myself as: (Strongly disagree)1-2-3-4-5-6-7 (Strongly agree)

1. Extraverti, enthousiaste _____

2. Critique, agressif _____

3. Digne de confiance, autodiscipliné _____

4. Anxieux, facilement troublé _____

5. Ouvert à de nouvelles expériences, d'une personnalité complexe _____

6. Réservé, tranquille _____

7. Sympathique, chaleureux _____

8. Désorganisé, négligent _____

9. Calme, émotionnellement stable _____

10. Conventionnel, peu créatif _____

10-item personality inventory (TIPI)

	Pas du tout d'accord			Ni d'accord Ni pas d'accord			Tout à fait d'accord
Je me considère comme étant :	1	2	3	4	5	6	7
Anxieux, facilement troublé							
Réservé, tranquille							
Extraverti, enthousiaste							
Critique, agressif							
Digne de confiance, autodiscipliné							
Ouvert à de nouvelles expériences, d'une personnalité complexe							
Sympathique, chaleureux							
Désorganisé, négligent							
Calme, émotionnellement stable							
Conventionnel, peu créatif							
Rebelle							
Porté sur la santé							
Libre et indépendant							

10-item personality inventory (TIPI)

Scoring the TIPI

1. Recode the reverse-scored items (i.e., recode a 7 with a 1, a 6 with a 2, a 5 with a 3, etc.). The reverse scored items are 2, 4, 6, 8, & 10.

2. Take the AVERAGE of the two items (the standard item and the recoded reverse-scored item) that make up each scale.

Example using the Extraversion scale: A participant has scores of 5 on item 1 (Extraverted, enthusiastic) and and 2 on item 6 (Reserved, quiet). First, recode the reverse-scored item (i.e., item 6), replacing the 2 with a 6. Second, take the average of the score for item 1 and the (recoded) score for item 6. So the TIPI Extraversion scale score would be: (5 + 6)/2 = 5.5

Extraversion: 1, 6R;
Agreeableness: 2R, 7;
Conscientiousness; 3, 8R;
Emotional Stability: 4R, 9;
Openness to Experiences: 5, 10R.

10-item personality inventory (TIPI)

I see myself as:

1. Extraverted, enthusiastic. **6**

2. Critical, quarrelsome. **6**

3. Dependable, self-disciplined. **7**

4. Anxious, easily upset. **5**

5. Open to new experiences, complex. **7**

6. Reserved, quiet. **4**

7. Sympathetic, warm. **5**

8. Disorganized, careless. **1**

9. Calm, emotionally stable. **2**

10. Conventional, uncreative. **2**

Extraversion: 1, 6R;
(6+4R)/2 = (6+4)/2=5

Agreeableness: 2R, 7;
(6R+5)/2=(2+5)/2=3.5

Conscientiousness; 3, 8R;
(7+1R)/2=(7+7)/2=7

Emotional Stability: 4R, 9;
(5R+2)/2=(3+2)/2=2.5

Openness to Experiences: 5, 10R.
(7+2R)/2=(7+6)/2=6.5

10-item personality inventory (TIPI)

Male norms

		Male					
Age group		**Extraversion**	**Agreeableness**	**Conscientiousness**	**Emotional Stability**	**Openness**	
15 to 20	**Mean**	3.79	4.47	4.41	4.61	5.43	
	SD	1.55	1.22	1.39	1.47	1.17	
	n =	54973	54973	54973	54973	54973	
21 to 30	**Mean**	3.73	4.5	4.57	4.64	5.49	
	SD	1.54	1.2	1.39	1.46	1.13	
	n =	40737	40737	40737	40737	40737	
31 to 40	**Mean**	3.81	4.55	4.77	4.63	5.49	
	SD	1.54	1.21	1.35	1.42	1.12	
	n =	14752	14752	14752	14752	14752	
41 to 50	**Mean**	3.85	4.7	4.96	4.72	5.41	
	SD	1.54	1.18	1.35	1.39	1.17	
	n =	7668	7668	7668	7668	7668	
51 to 60	**Mean**	3.87	4.89	5.11	4.8	5.39	
	SD	1.54	1.18	1.31	1.38	1.2	
	n =	3532	3532	3532	3532	3532	
61 and older	**Mean**	3.85	4.95	5.26	4.92	5.37	
	SD	1.49	1.17	1.3	1.34	1.26	
	n =	905	905	905	905	905	

10-item personality inventory (TIPI)

Female norms

		Female					
Age group		**Extraversion**	**Agreeableness**	**Conscientiousness**	**Emotional Stability**	**Openness**	
15 to 20	**Mean**	4.06	4.73	4.52	4.07	5.58	
	SD	1.58	1.22	1.42	1.46	1.1	
	n =	79648	79648	79648	79648	79648	
21 to 30	**Mean**	4.07	4.88	4.78	4.09	5.55	
	SD	1.61	1.19	1.41	1.45	1.12	
	n =	46530	46530	46530	46530	46530	
31 to 40	**Mean**	4.17	5.04	4.97	4.25	5.49	
	SD	1.64	1.19	1.41	1.45	1.18	
	n =	15412	15412	15412	15412	15412	
41 to 50	**Mean**	4.2	5.28	5.18	4.49	5.46	
	SD	1.64	1.17	1.36	1.45	1.2	
	n =	8823	8823	8823	8823	8823	
51 to 60	**Mean**	4.18	5.43	5.35	4.66	5.42	
	SD	1.6	1.14	1.31	1.44	1.25	
	n =	4135	4135	4135	4135	4135	
61 and older	**Mean**	4.21	5.5	5.39	4.84	5.39	
	SD	1.62	1.15	1.36	1.4	1.27	
	n =	885	885	885	885	885	

My score before: 5 - 3.5 - 7 - 2.5 - 6.5

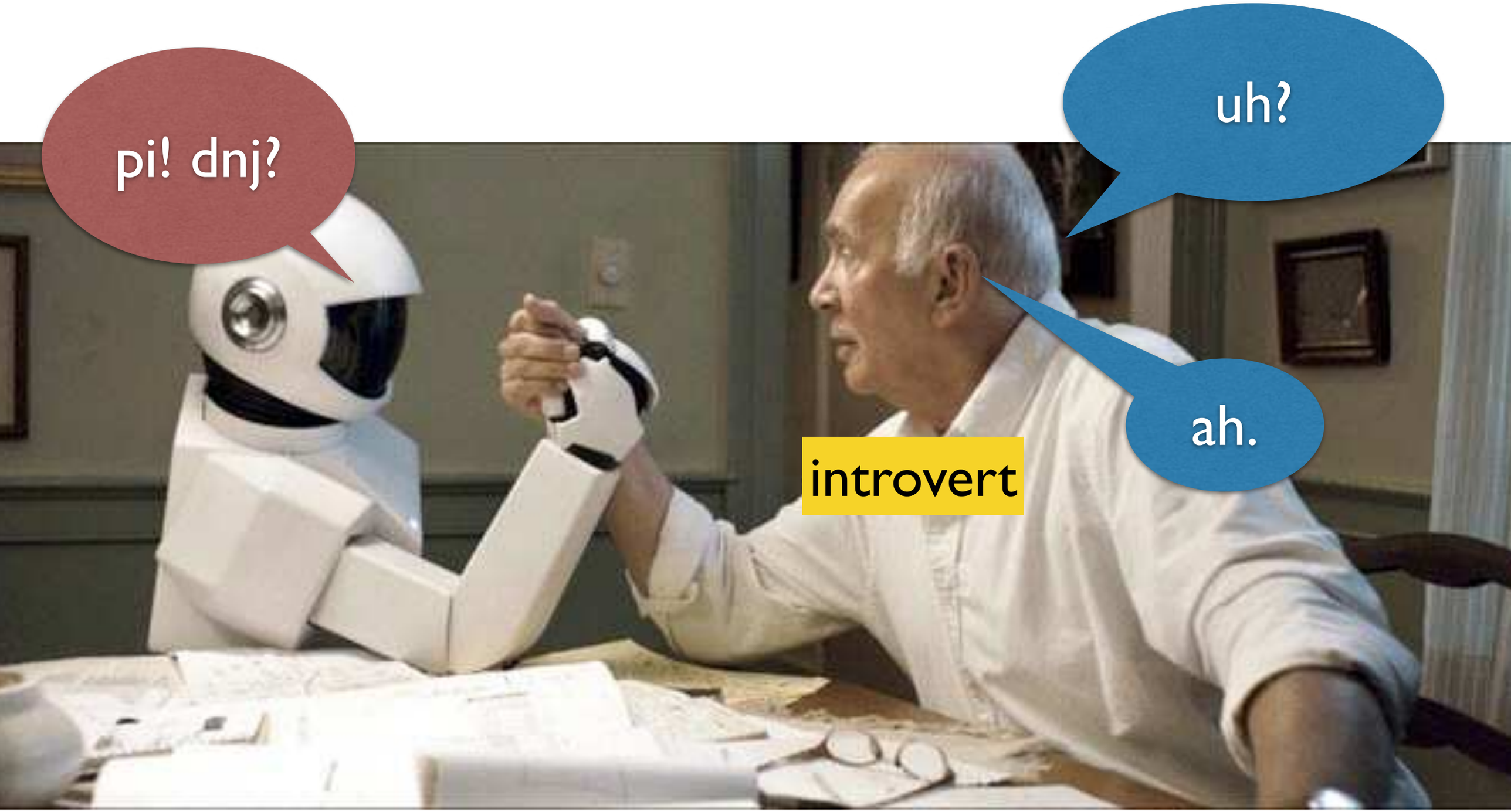
Why personality is useful in HRI

- Personality traits influence people acceptance of technology in general (Alavi & Joachimsthaler, 1992) and robots in particular (Fischer, 2011; Looije et al., 2010; Weiss et al. 2008).
  - extroverts tend to trust robots more than introverts (McBride & Morgan, 2010)
  - proactive people keep higher distance from the robot than others (Walters et al, 2005)
  - people with negative attitude towards robots respond slower to the robot's speech (Nomura et al, 2006)

- Personality traits may correlate with task performances
  - extroversion influence tasks that do not enforce very short time constraints, while agreeableness is important in tasks with high level of collaboration (Mc Givney et al, 2008)
  - the more people are extrovert, the more they talk to the robot (Ivaldi et al, 2015)

Robot actions customised on the user

Robot actions customised on the user

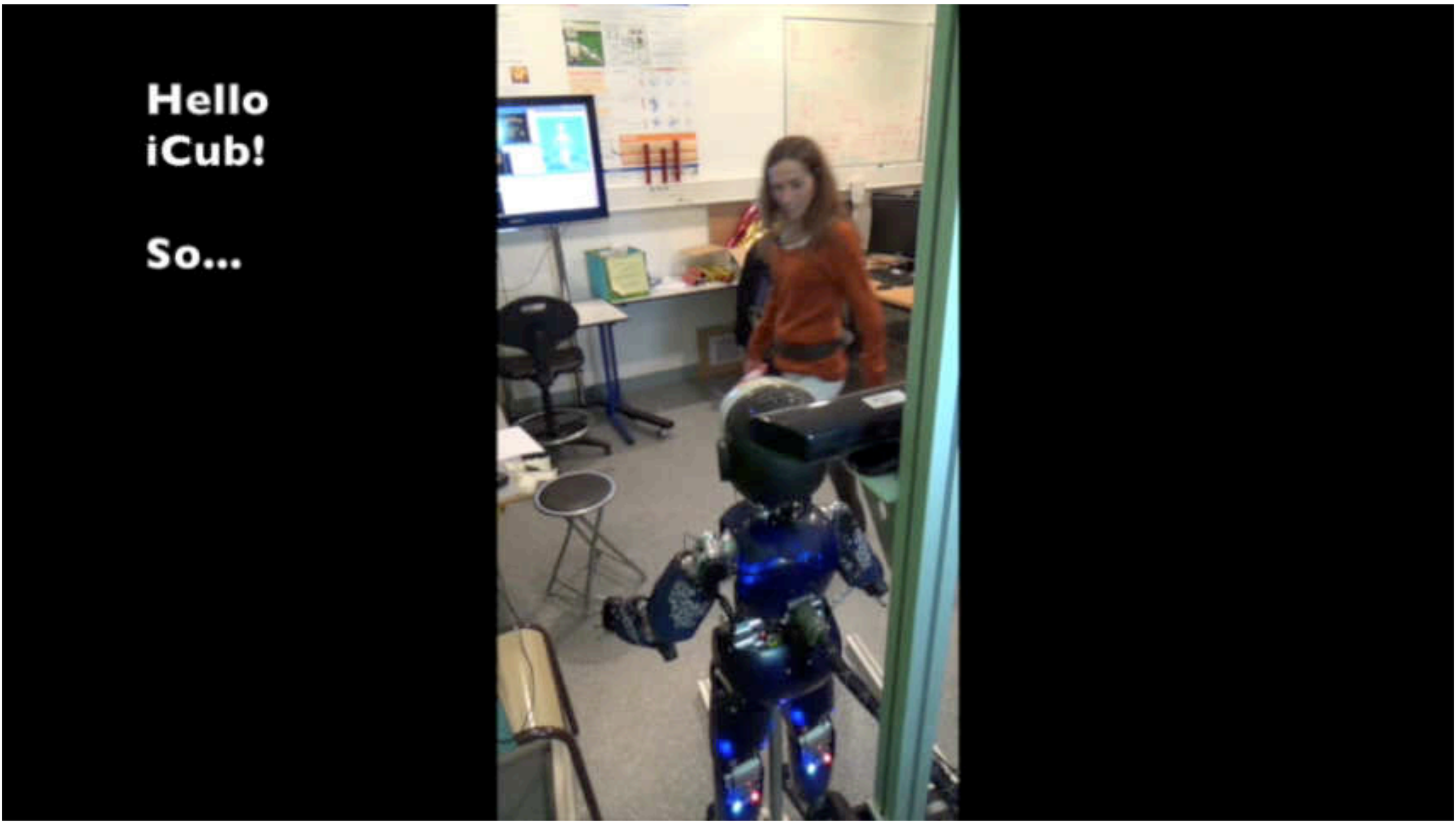


Humans are very good at modelling

- Perceiving and judging other people's personality traits is essential for our social living
- It helps taking decisions
- People are fairly good at judging each other's personalities, even strangers
- Complete strangers can make valid personality judgments after watching a short video presenting a sample of behavior (Borkenau & Liebler, 1993; Carney et al., 2007)

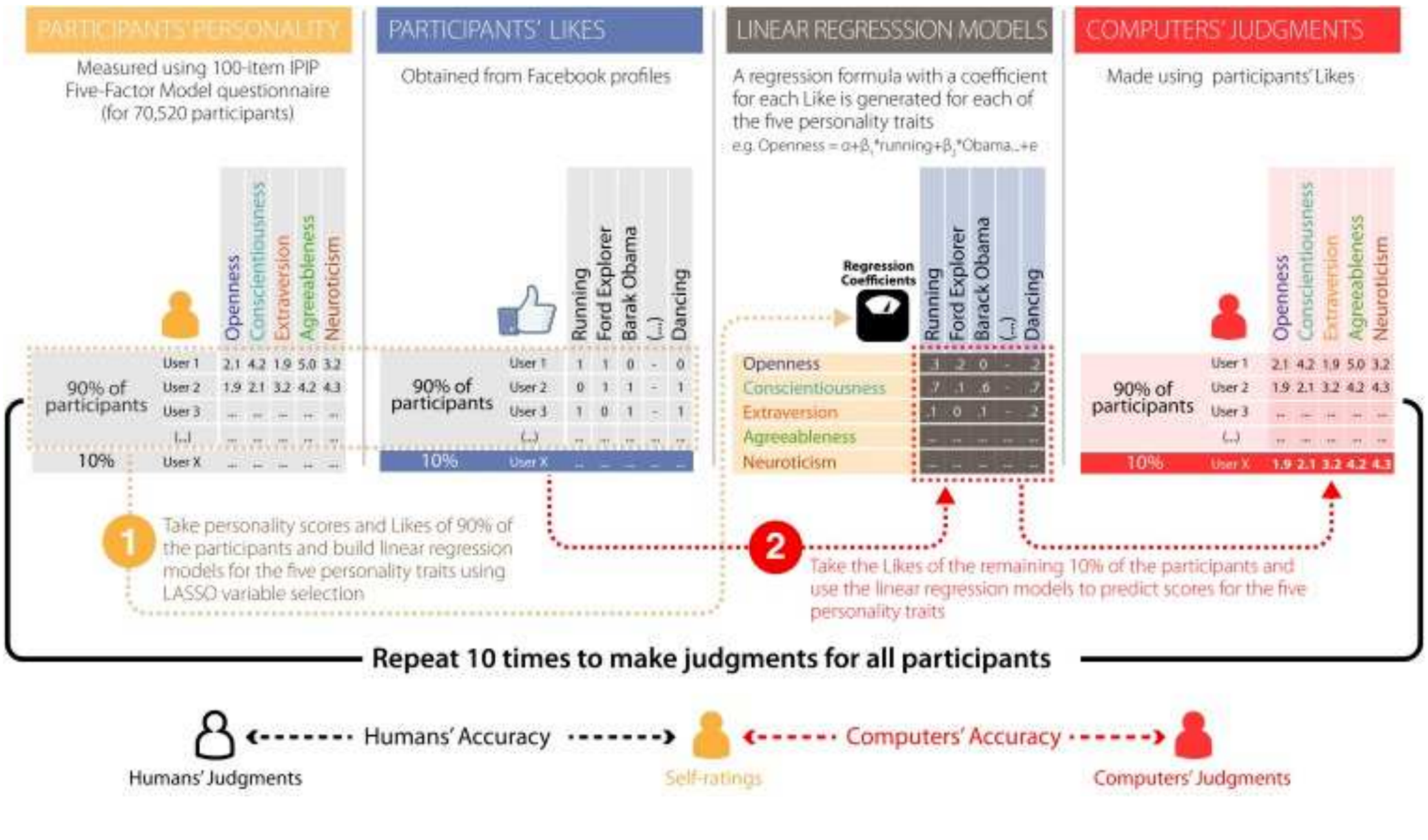
Let's try together!

What can you say about these people?



Can a computer be better?

If they have information about your Facebook likes apparently they can be better than your friends in judging your personality (Youyou et al, 2005, PNAS).



Can robots estimate the personality ?

Before starting the three tasks, we introduce the robot to the participants. They do not know that this is a test belonging to the experiment. We don't intervene in their first interaction.

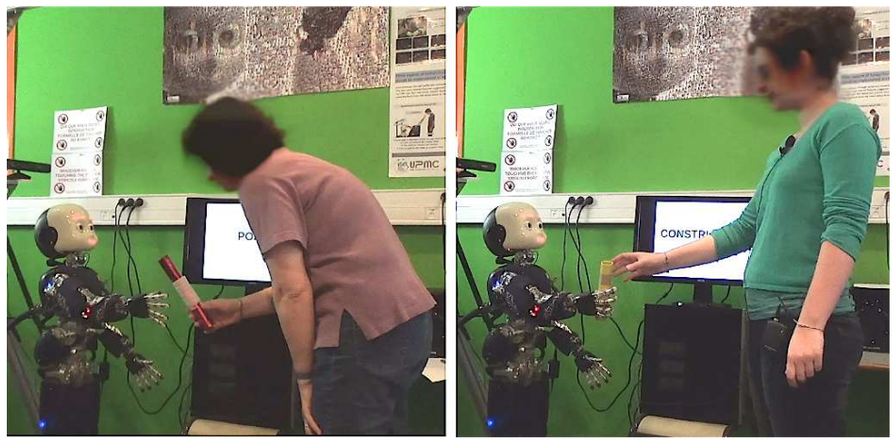
When the robot moves its arm holding a cylinder, it creates the illusion of an intentional movement.

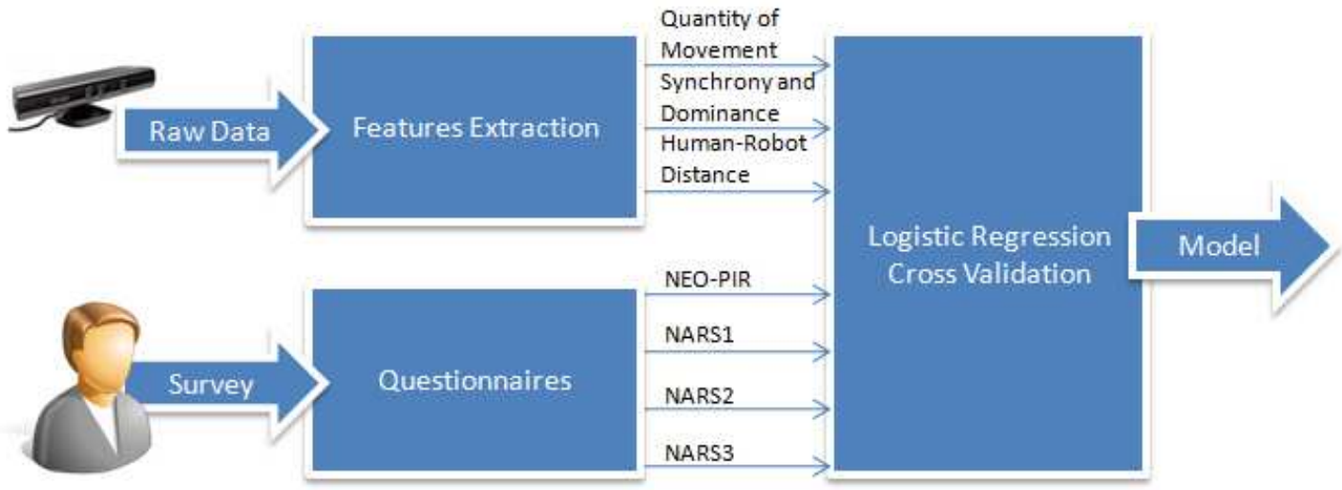
... 86% of the participants took the toy and started to play with the robot.

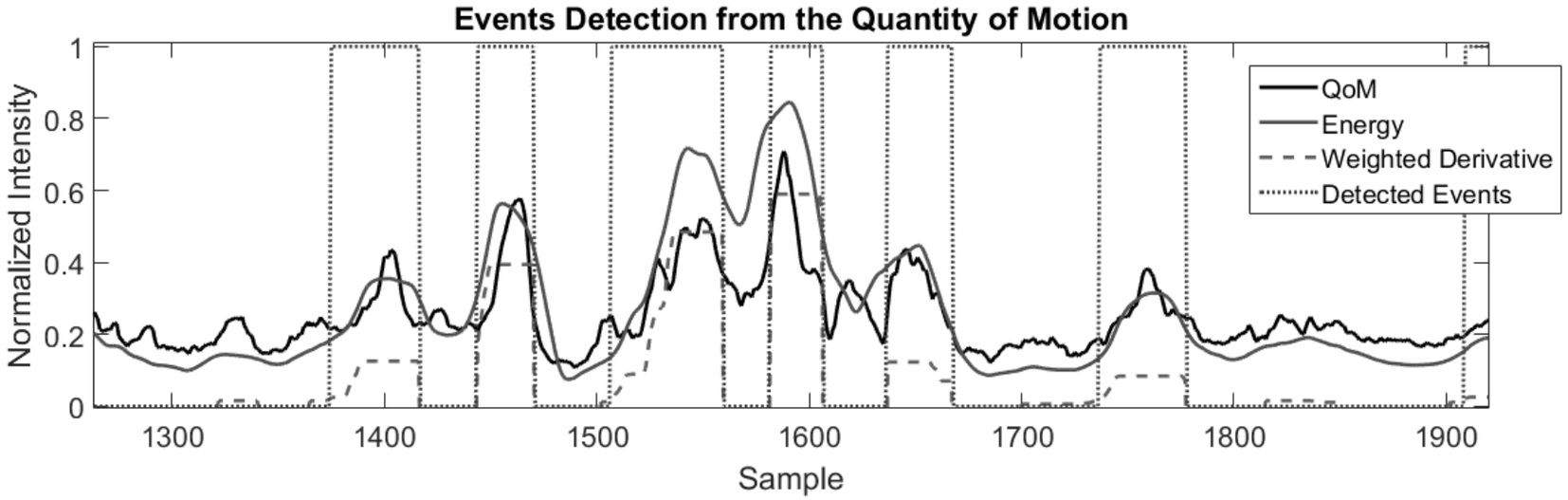
Here some interesting reactions ...

Rahbar, F.; Anzalone, S.; Varni, G.; Zibetti, E.; Ivaldi, S.; Chetouani, M. (2015) Predicting extraversion from non-verbal features during a face-to-face human-robot interaction. International Conference on Social Robotics.

Predicting extraversion from non-verbal features







selected features:

1)STD-d : standard deviation of H-R distance

2)h-QoM: histogram if Quantity of Motion

3)h-sync: histogram of synchrony

4)h-dom: histogram of dominance

Features	Precision	Recall	F-score
std-d, h-QoM	33%	27%	46%
std-d, h-QoM, h-dom	59%	62%	61%
std-d, h-QoM, h-sync	60%	64%	63%
std-d, h-QoM, h-sync, h-dom	64%	69%	66%

Rahbar, F.; Anzalone, S.; Varni, G.; Zibetti, E.; Ivaldi, S.; Chetouani, M. (2015) Predicting extraversion from non-verbal features during a face-to-face human-robot interaction. International Conference on Social Robotics.

Questions ?

Comics by Fiamma Luzzati - Le Monde - April 2014