Social Robots

Filipa Correia

ISEG - MBA Student Trip

25/11/2021

Who am I?

Who am I?

TÉCNICO LISBOA

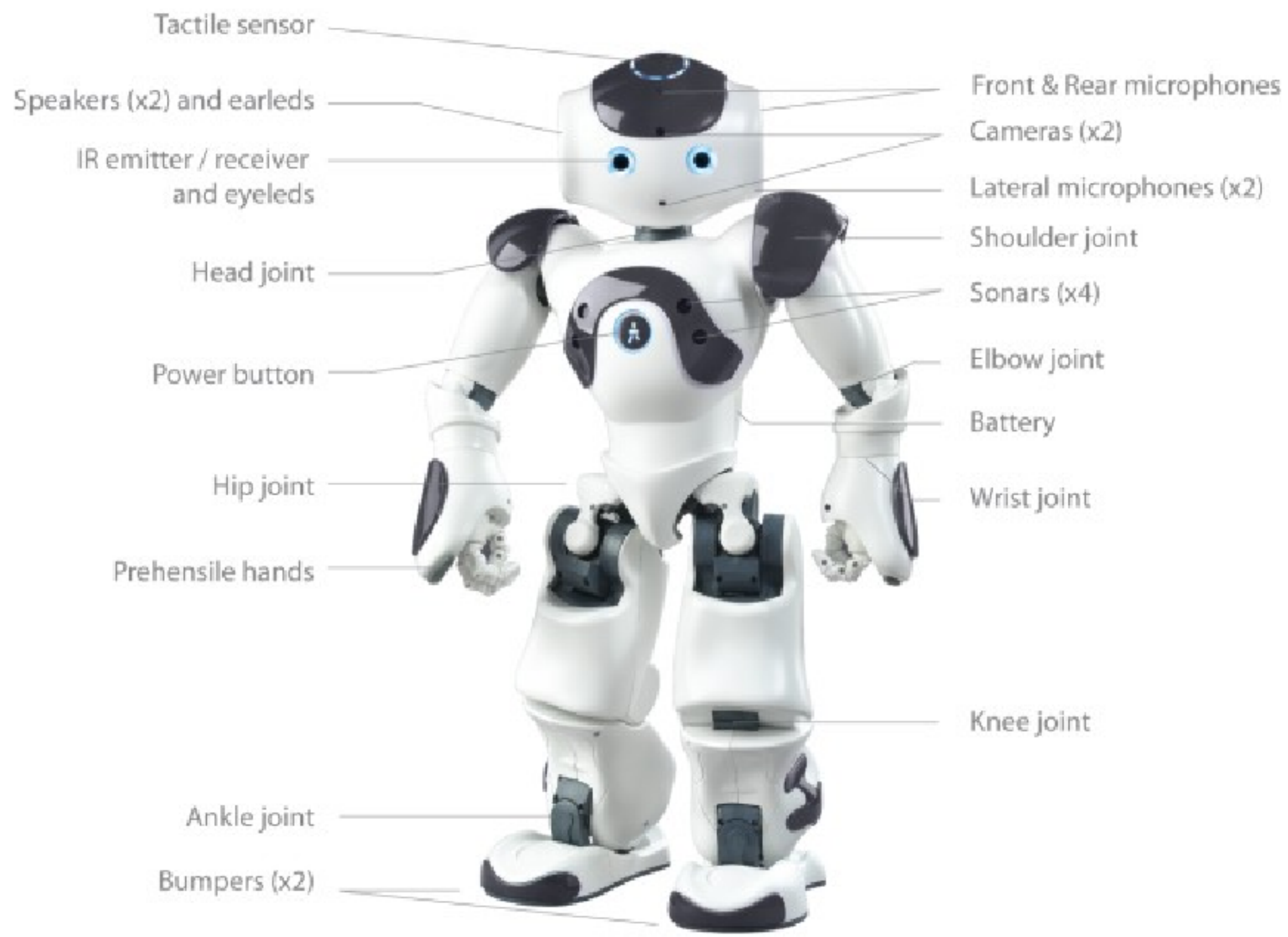
inesc id lisboa

Interactive Technologies Institute
LARSyS

What is a robot?

What is a robot?

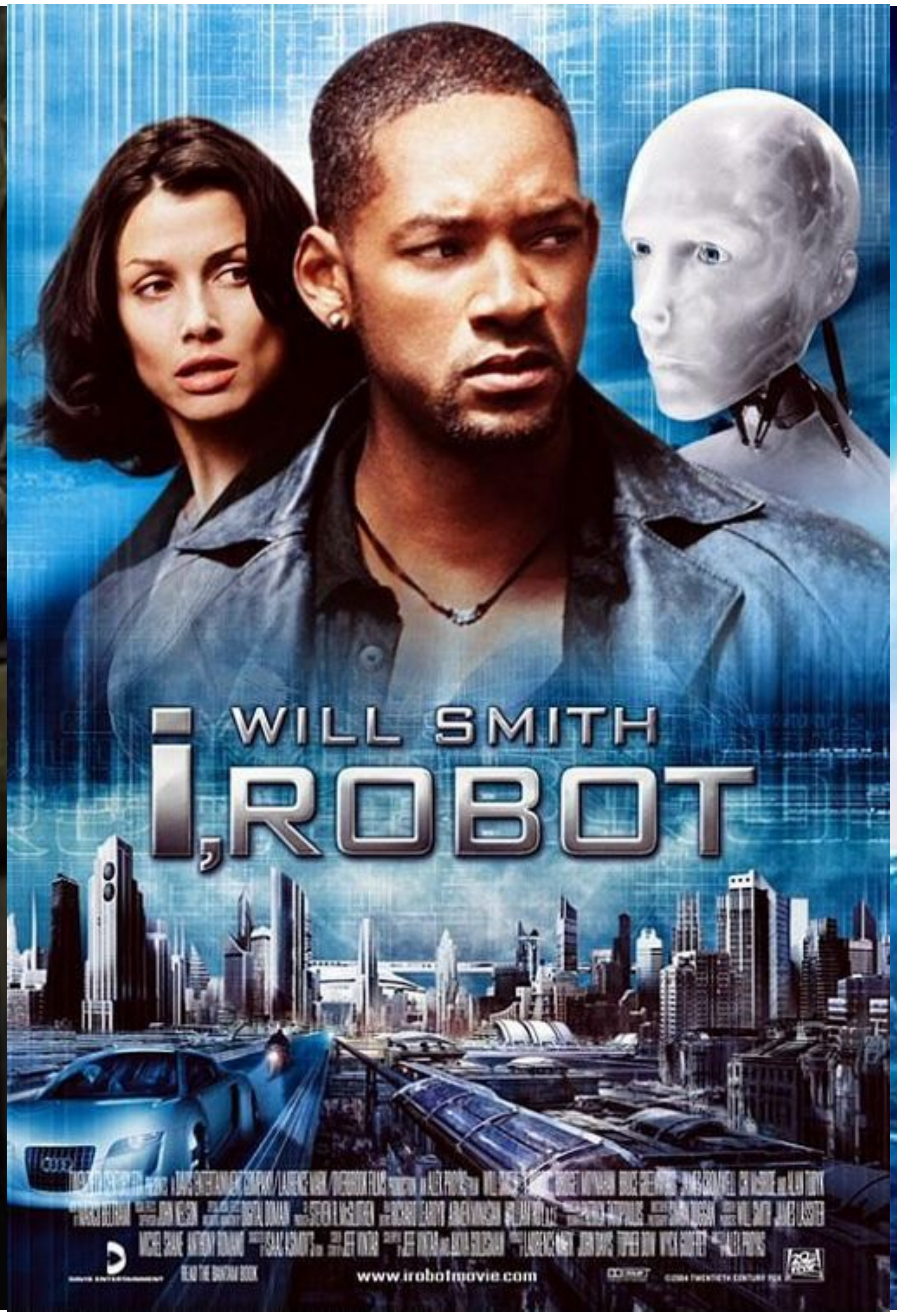
Sensors



Actuators

Which robots do we know?


STAR WARS


WILL SMITH
I, ROBOT
www.irobotmovie.com


FROM THE HUMANS WHO BROUGHT YOU "FINDING NEMO"
Disney · PIXAR
WALL·E
JUNE 27


Disney
BIG HERO 6

Which robots do actually exist?


ABB

And… what is a social robot?

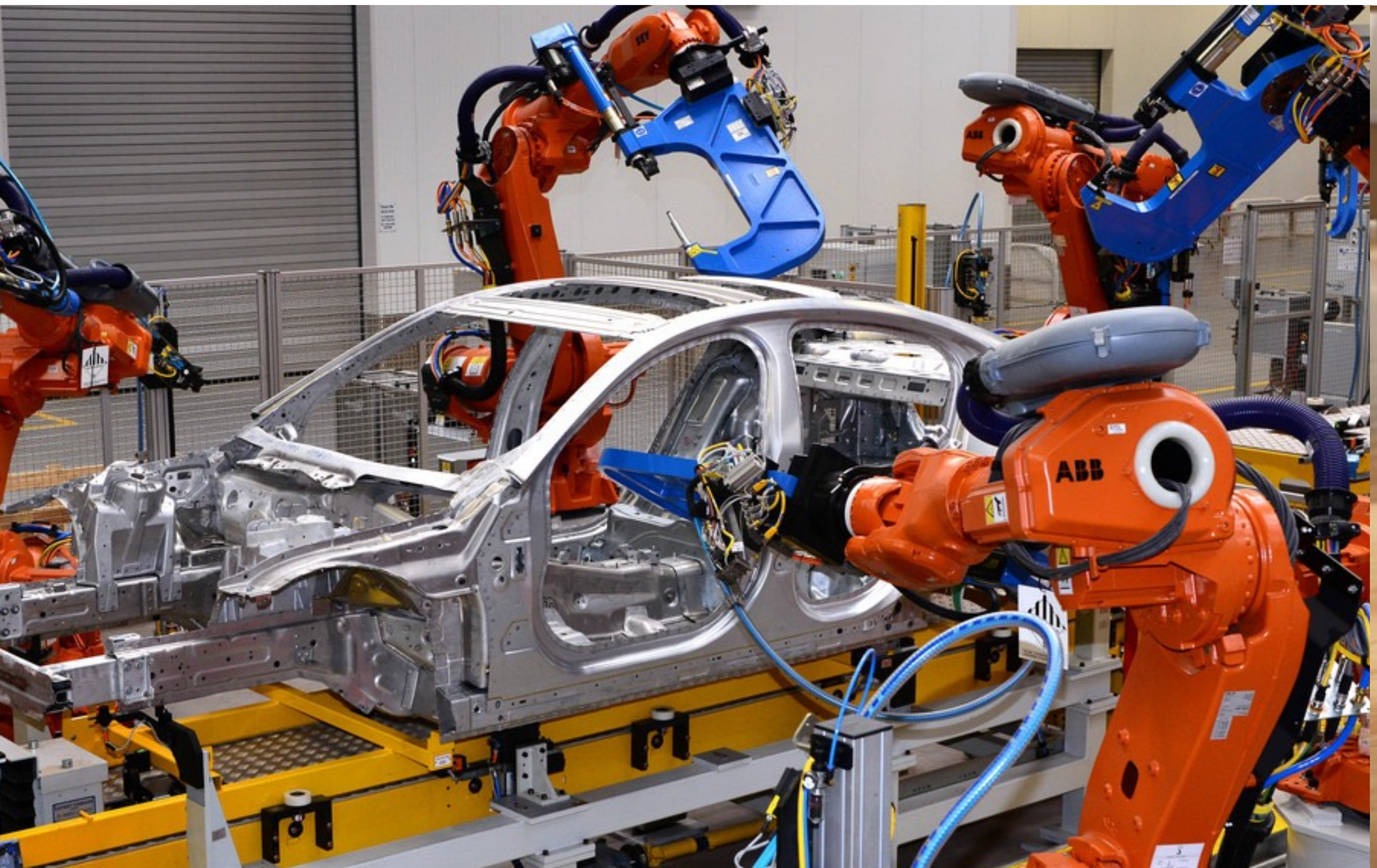
And… what is a social robot?

Uses its sensors to interpret humans' social behaviours

and / or

Uses its actuators to act in a social manner

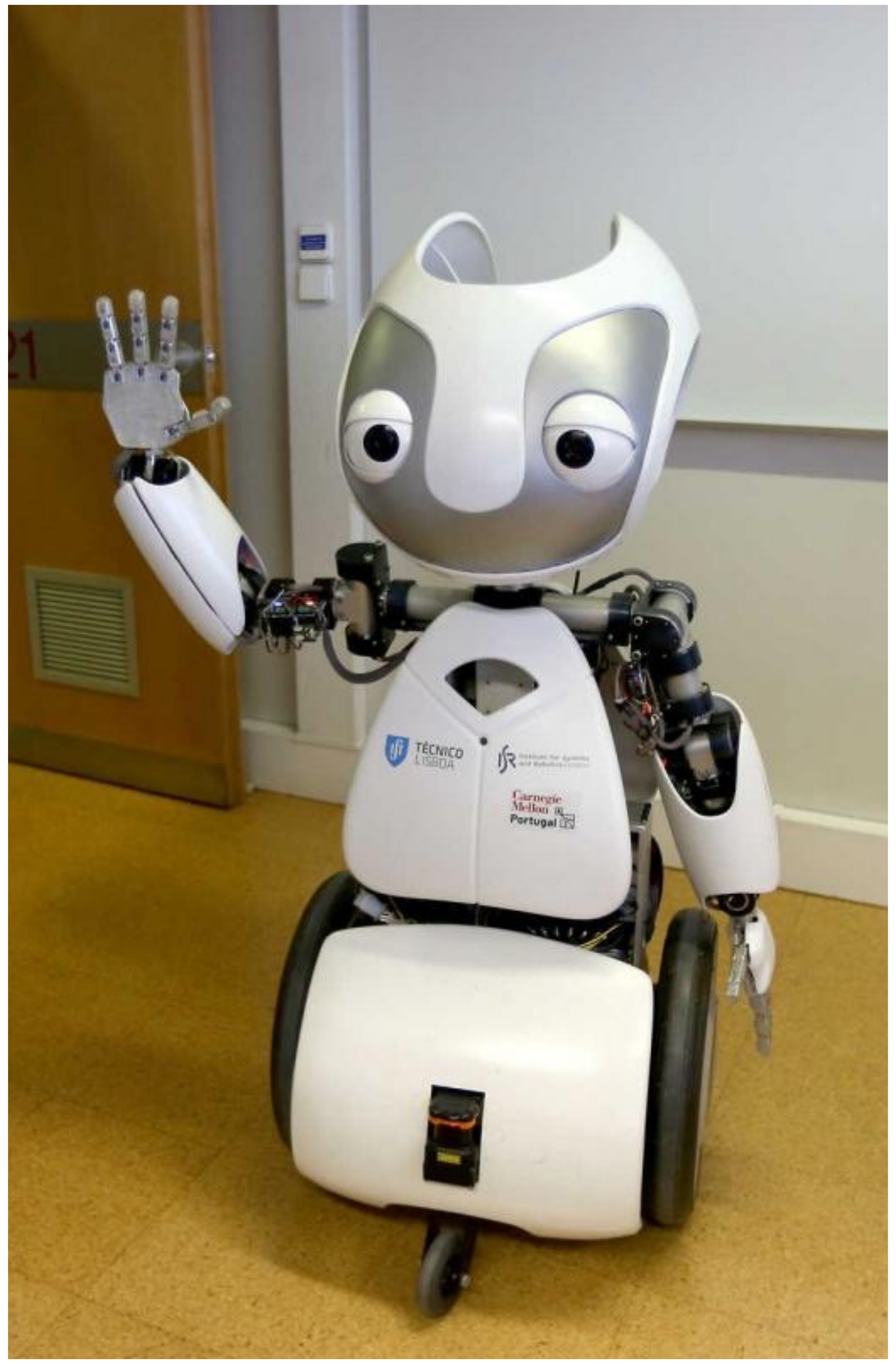
Are these robots social?



Are these robots social?

Probably not…


PORTA
Bem-vindo ao Centro Colombo!
Lojas
Restaurantes
Serviços
Mapa do centro
Horários
Medidas de Higiene e Segurança
Saber mais sobre o Pepper
Dar opinião sobre o Pepper



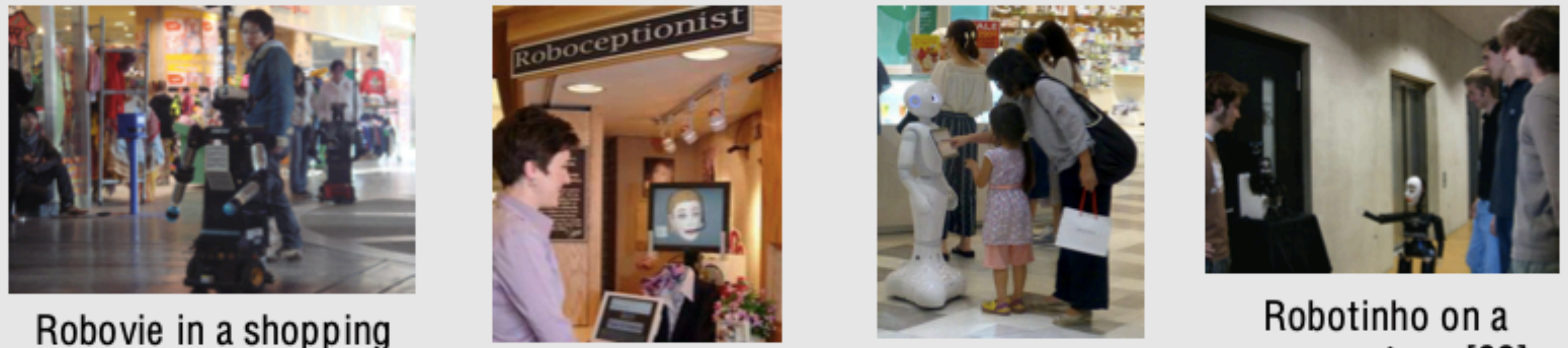

baxter
rethink robotics

Why do we need social robots?

Purpose and Application Area

Baraka et al., 2020

Public service



Robovie in a shopping mall [170]

Roboceptionist at department reception [79]

Pepper at a store entrance

Robotinho on a museum tour [63]

Purpose and Application Area

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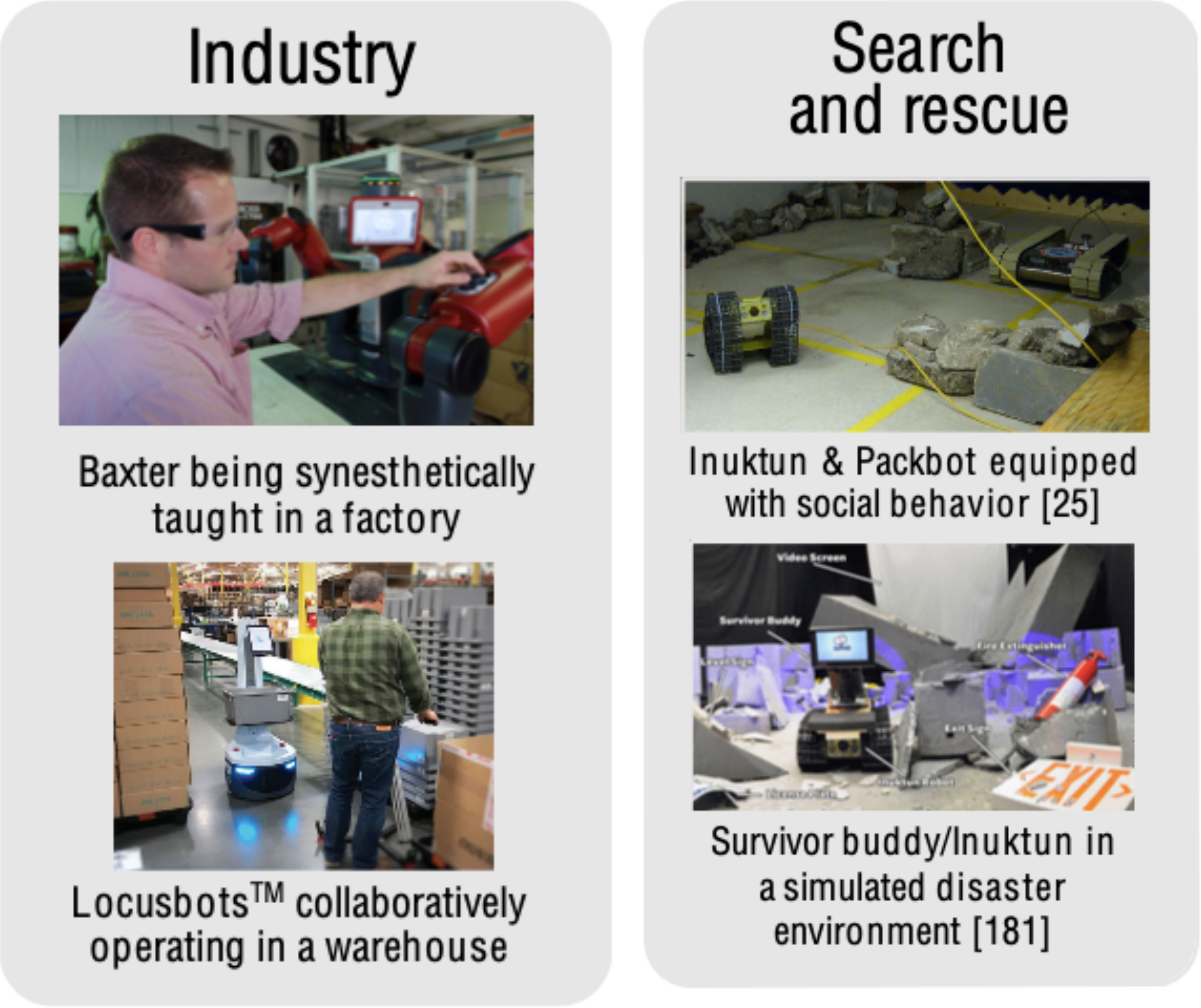

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Social sciences

Cog used to study human cognition

Robota used to study child development [53]

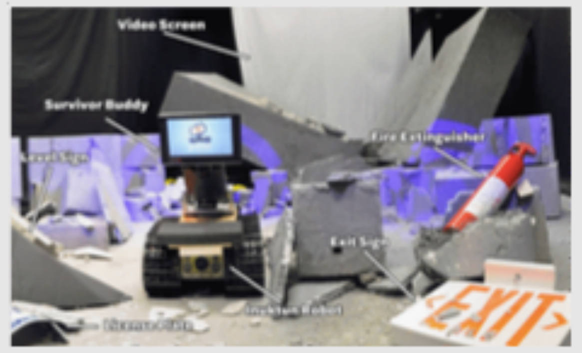
Industry

Baxter being synesthetically taught in a factory

Locusbots™ collaboratively operating in a warehouse

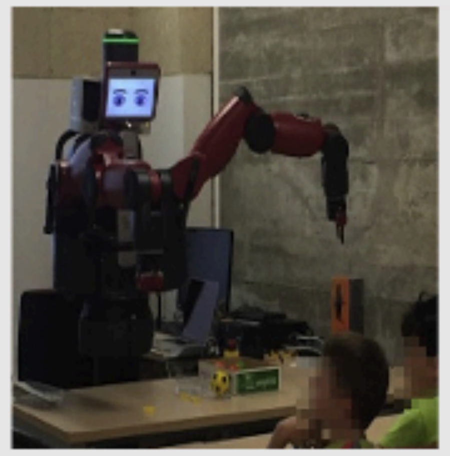
Search and rescue

Inuktun & Packbot equipped with social behavior [25]



Survivor buddy/Inuktun in a simulated disaster environment [181]

Education, entertainment and art



Baxter teaching children [67]

Bee-bot used for educational activities

HERB acting in a play [209]

Furby with a child

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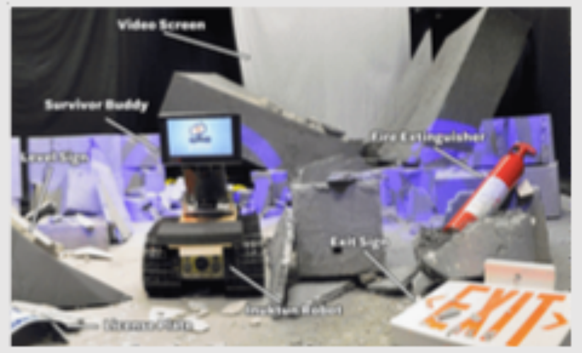
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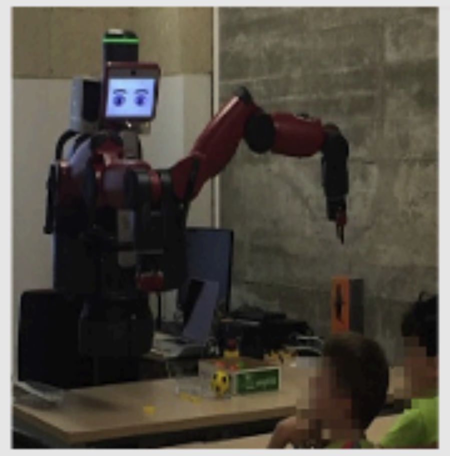
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Healthcare and therapy


NAO and child with ASD interacting [16]


Paro emotionally assisting the elderly [168]


Baxter assisting a blind person [31]


Robota assisting a child with ASD [29]


Pearl assisting an elder person [147]


SeRoDi assisting an elder person


Robear carrying a patient

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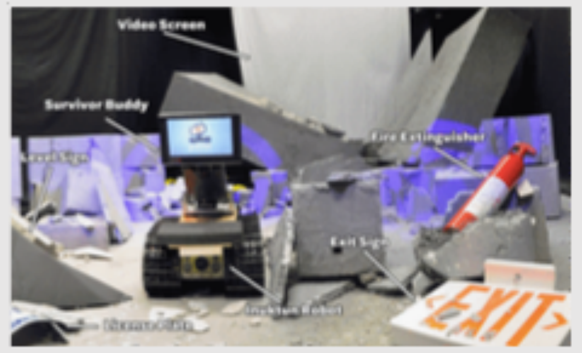
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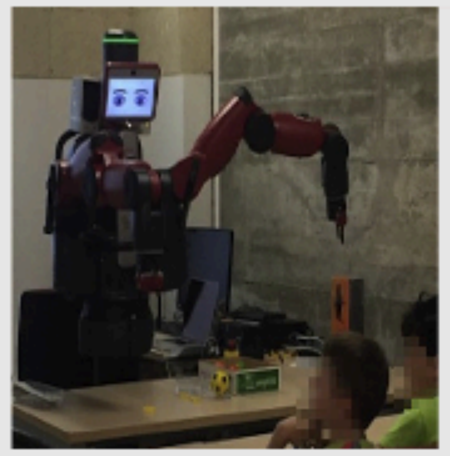
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Robear carrying a patient

Home and workplace

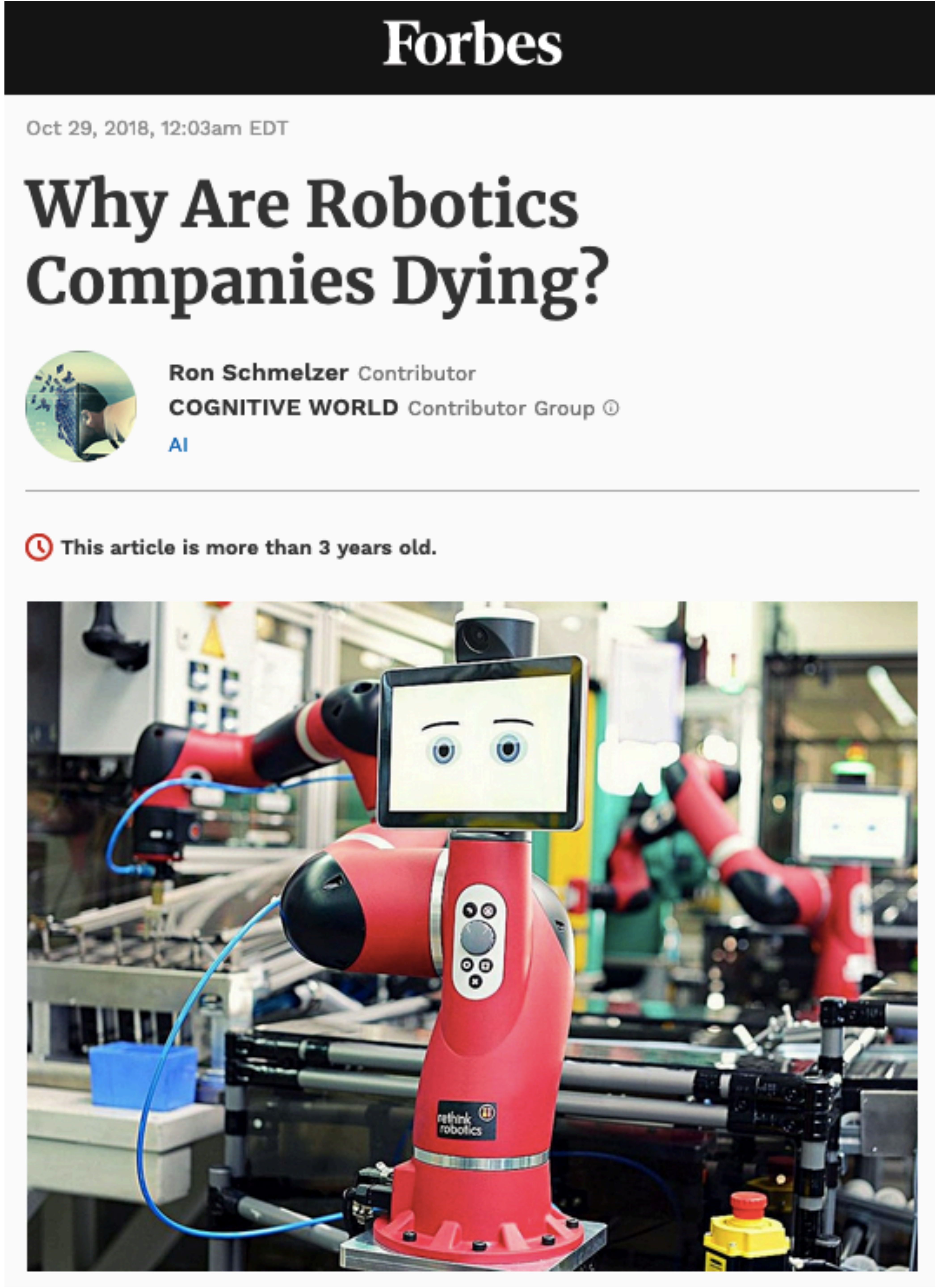

CoBot navigating an office corridor [19]


Care-O-bot 4 in a home


Bossa Nova's supermarket robot


HERB engaging in kitchen tasks

Why are not there yet many social robots?


Forbes

Oct 29, 2018, 12:03am EDT

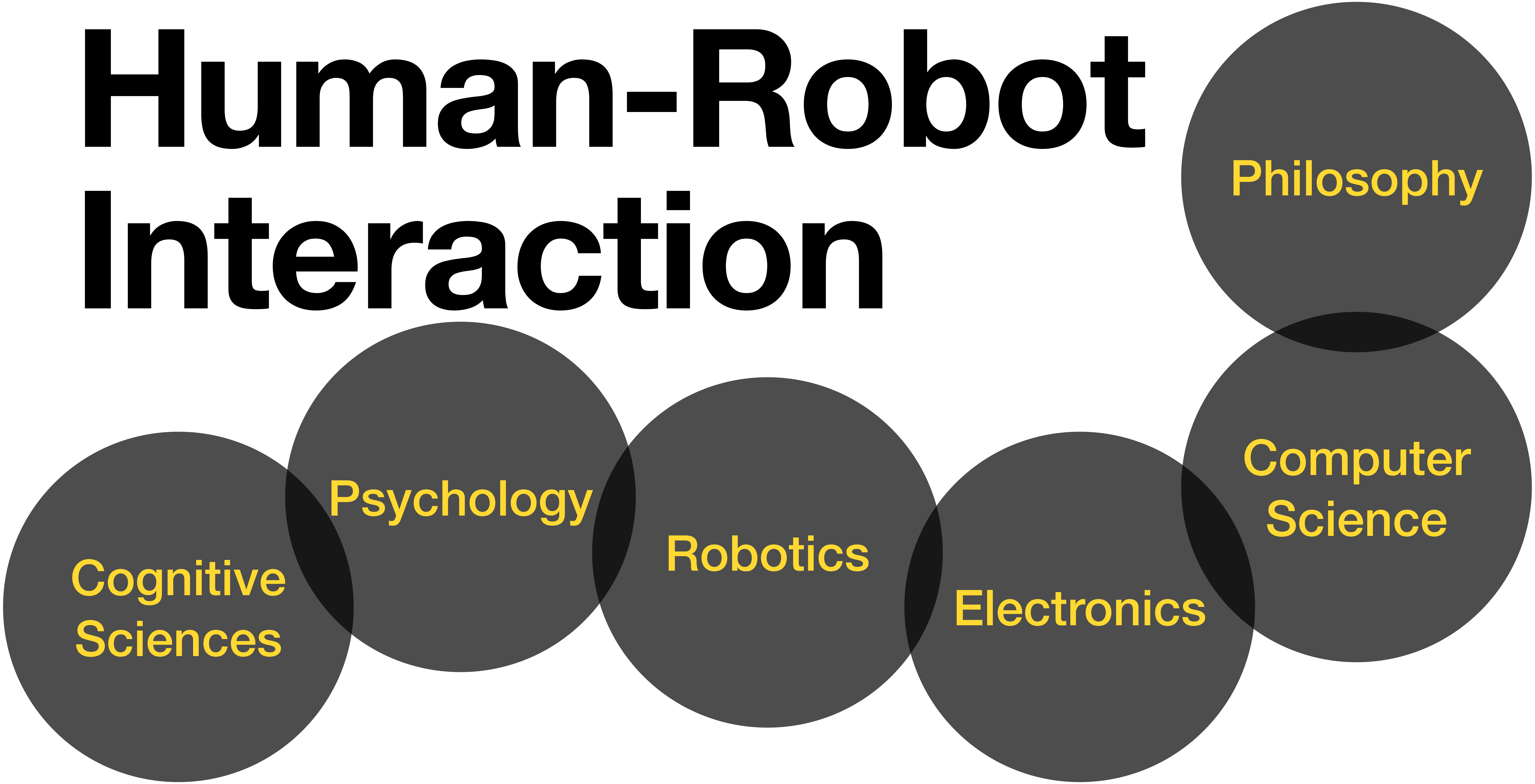
Why Are Robotics Companies Dying?

Ron Schmelzer Contributor
COGNITIVE WORLD Contributor Group
AI

This article is more than 3 years old.

Human-Robot Interaction is a multidisciplinary research field!

Human-Robot Interaction



Human-Robot Interaction

- Relational Role
- Proximity
- Robot Appearance
- Autonomy and Intelligence
- Social Capabilities

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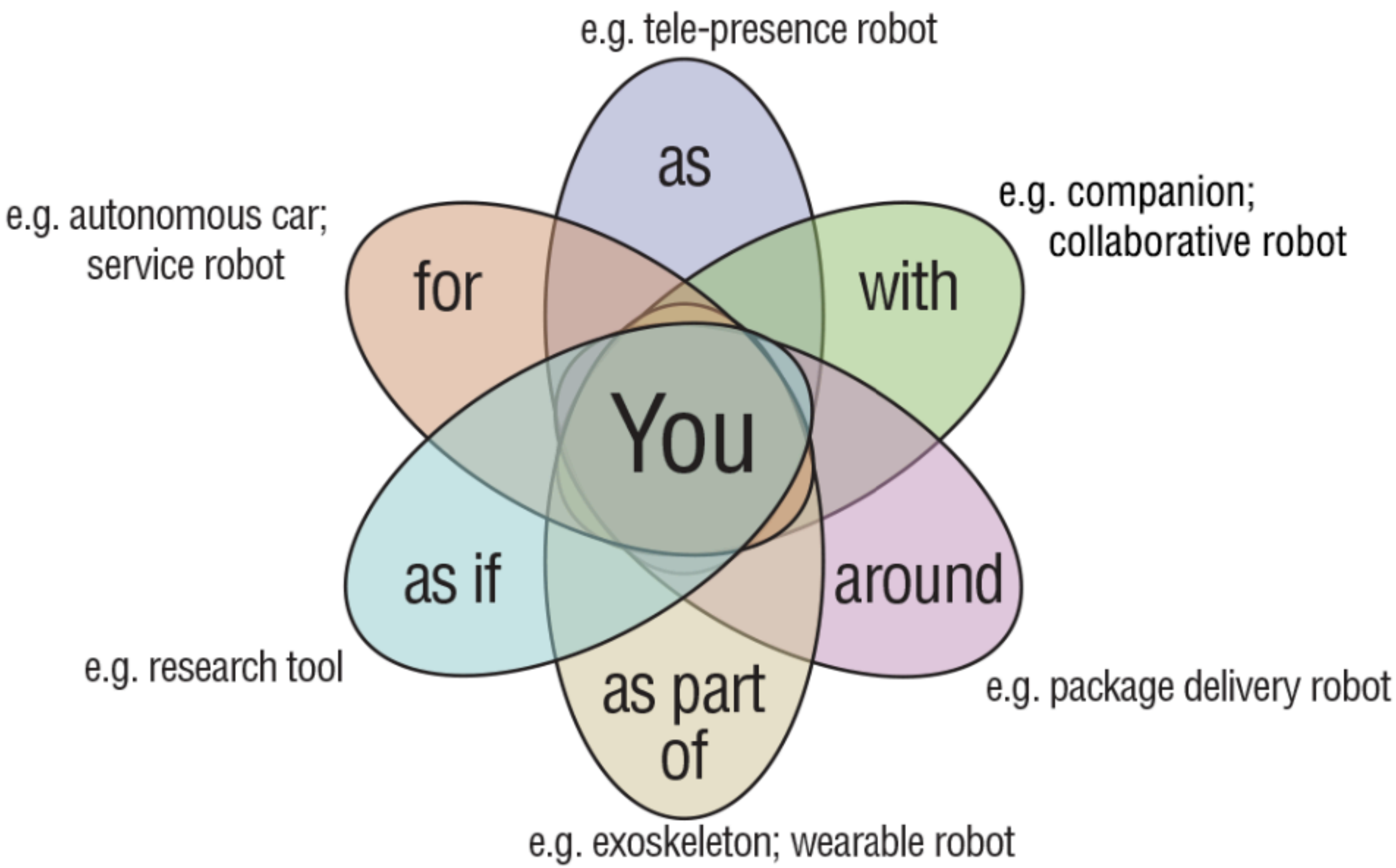
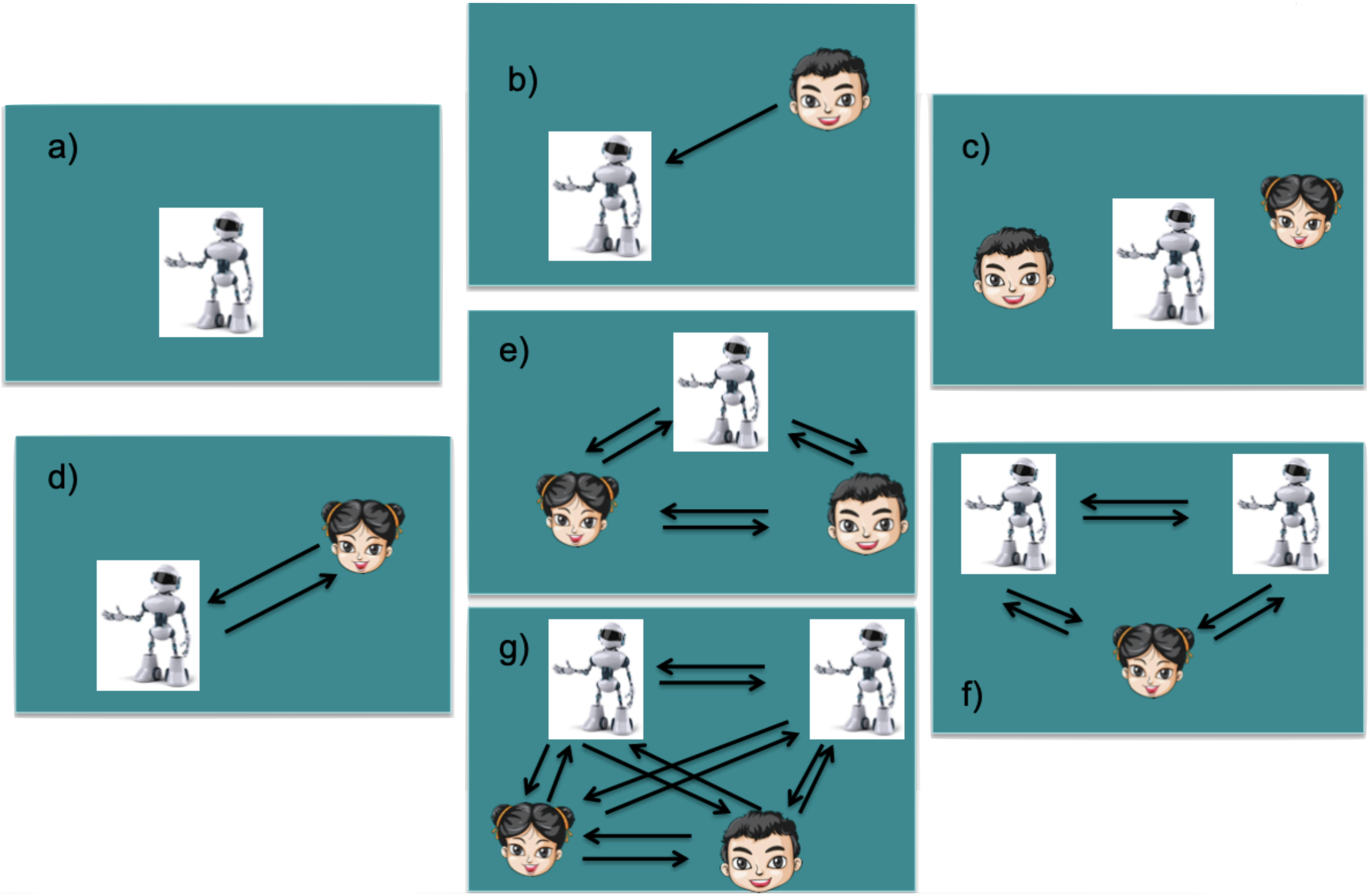
Relational Role

Baraka et al., 2020



Relational Role (topology)



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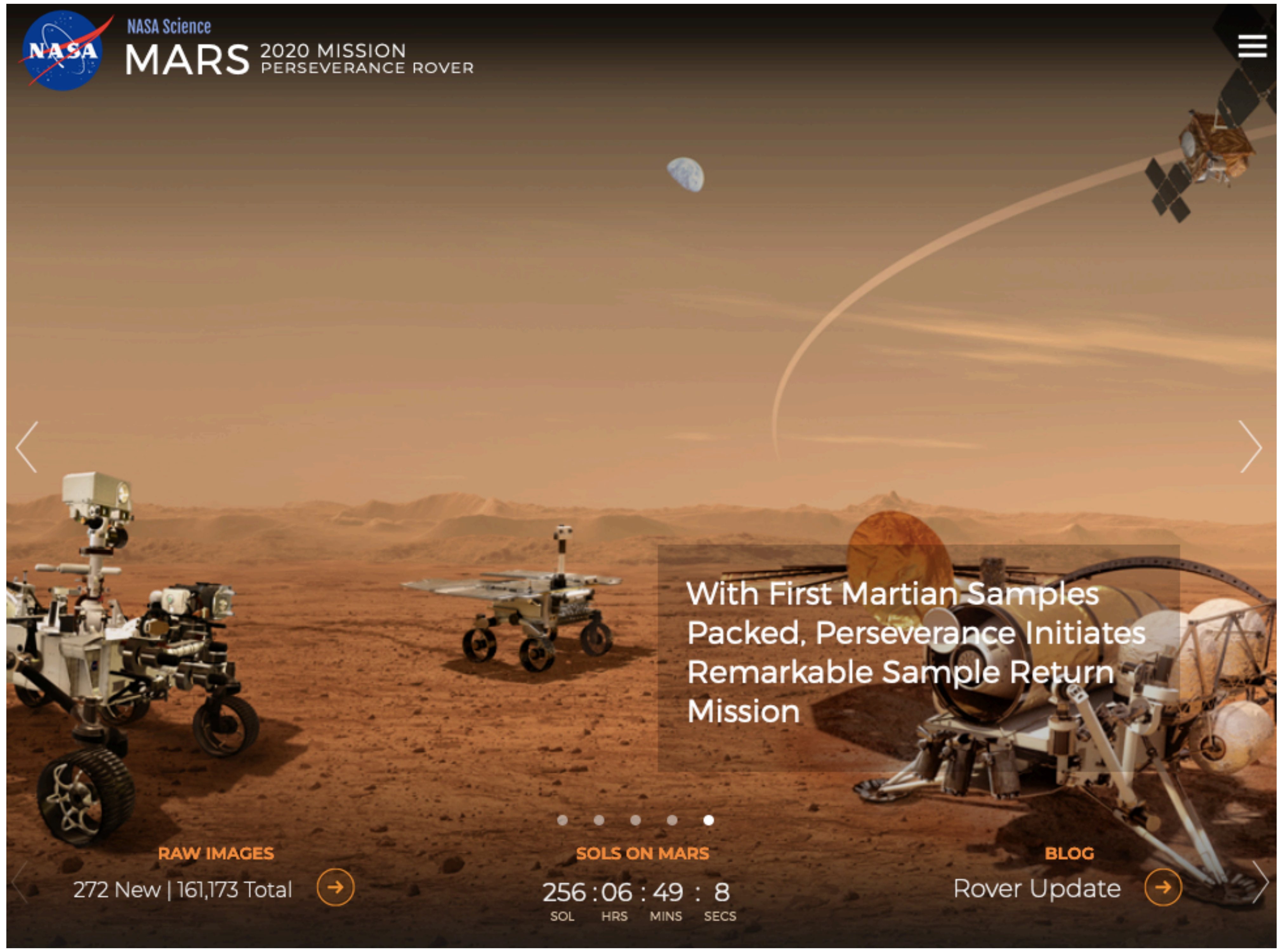
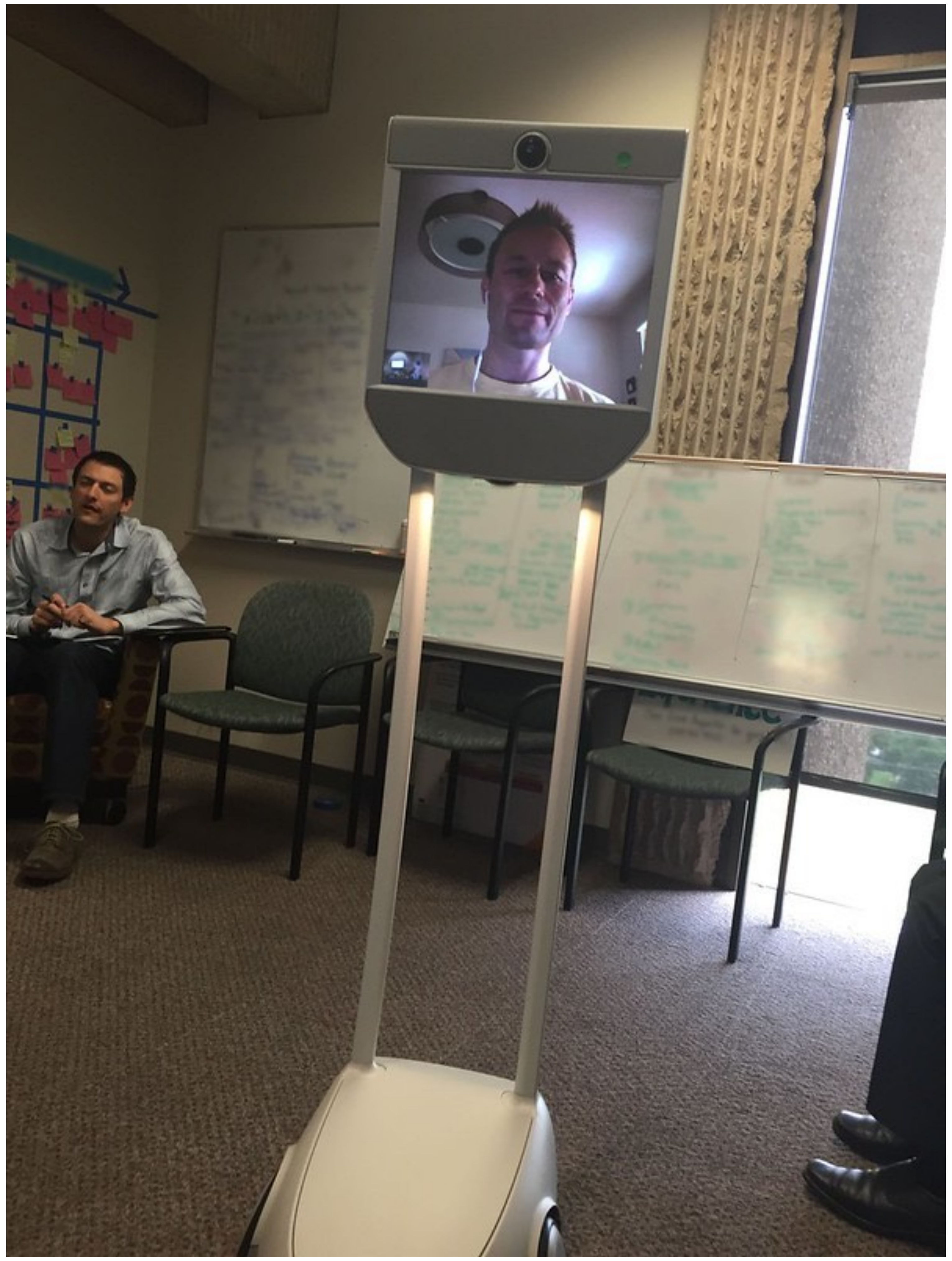
Proximity

- **Remote interaction**
  - Separated spatially or even temporally



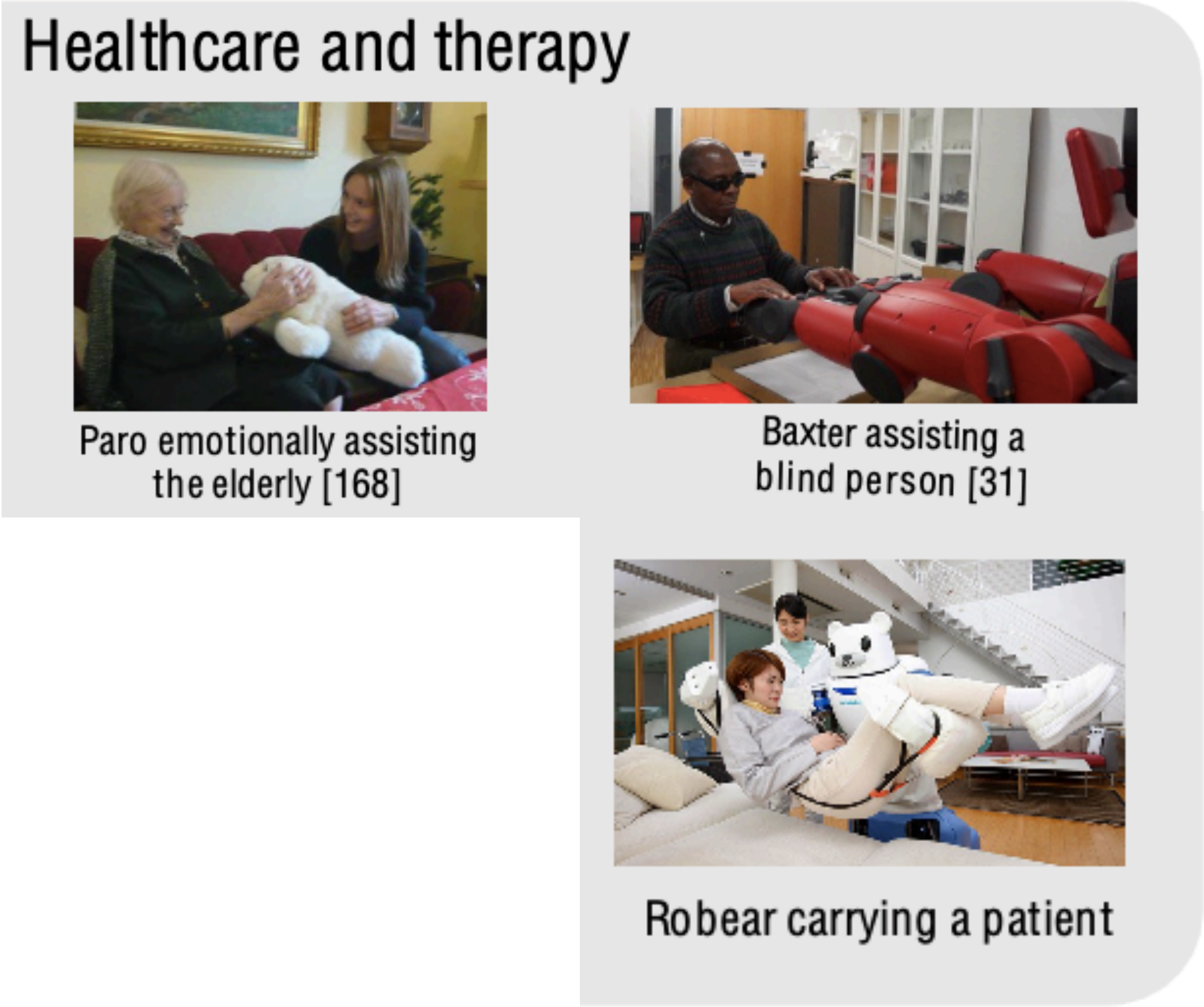


Proximity

- **Remote interaction**
  - Separated spatially or even temporally
- **Co-located interaction**
  - Without explicit physical contact

Proximity

- **Remote interaction**
  - Separated spatially or even temporally
- **Co-located interaction**
  - Without explicit physical contact
- **Physical interaction**



Proximity

- **Remote interaction**
  - Separated spatially or even temporally
- **Co-located interaction**
  - Without explicit physical contact
- **Physical interaction**
- **Deep interaction**
  - Humans and robots become one entity

Human-Robot Interaction

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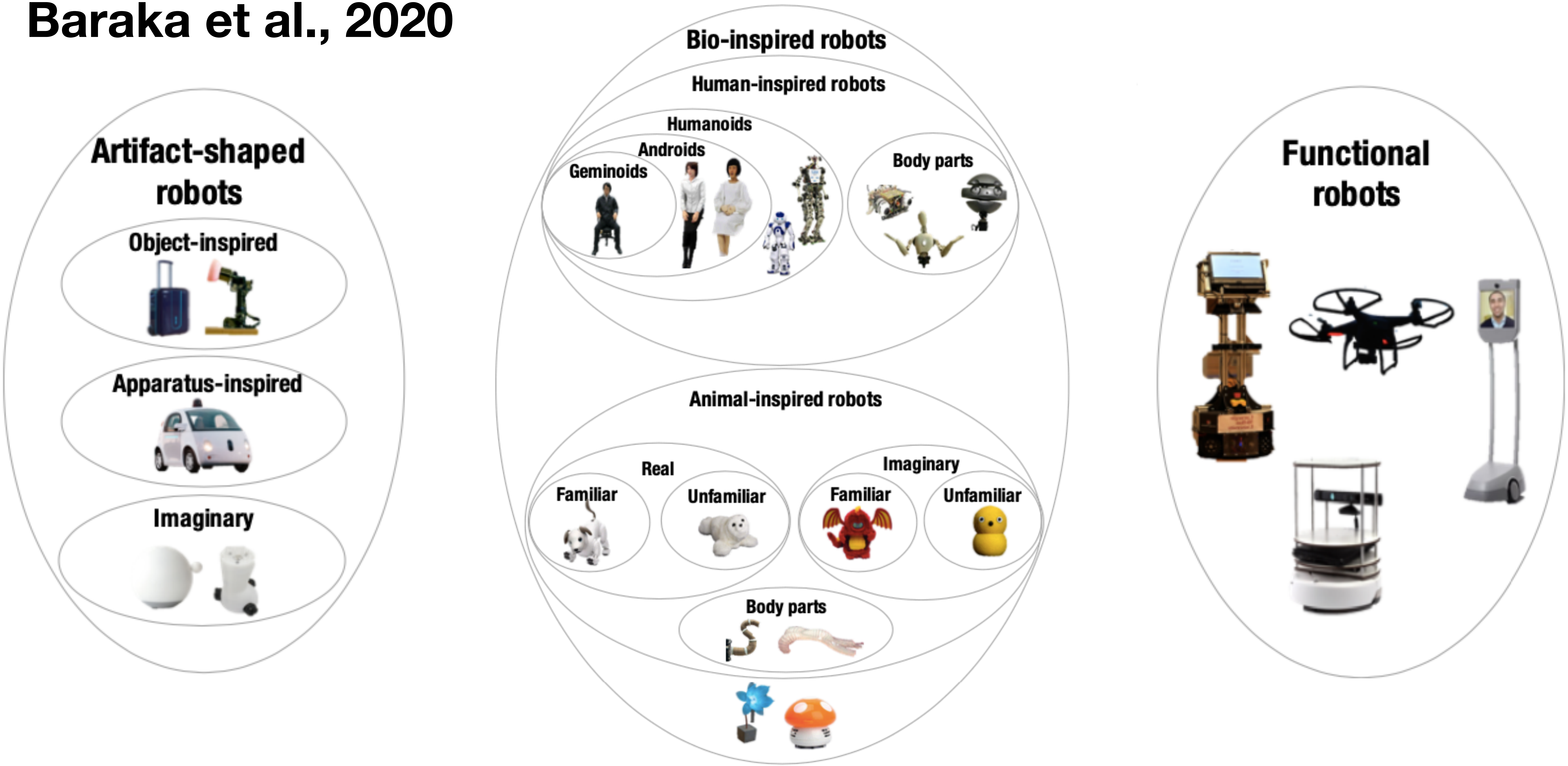
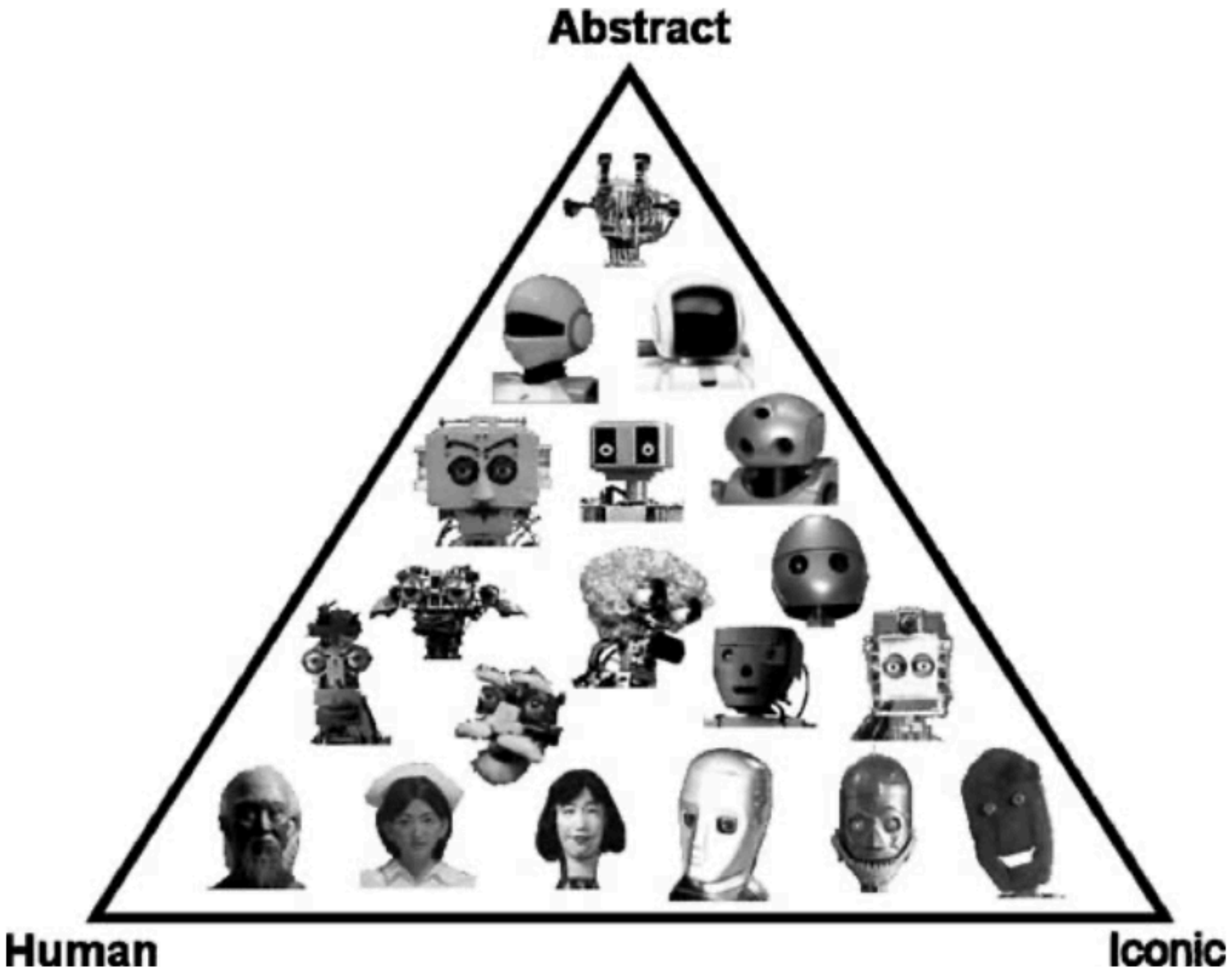
Robot Appearance

Baraka et al., 2020



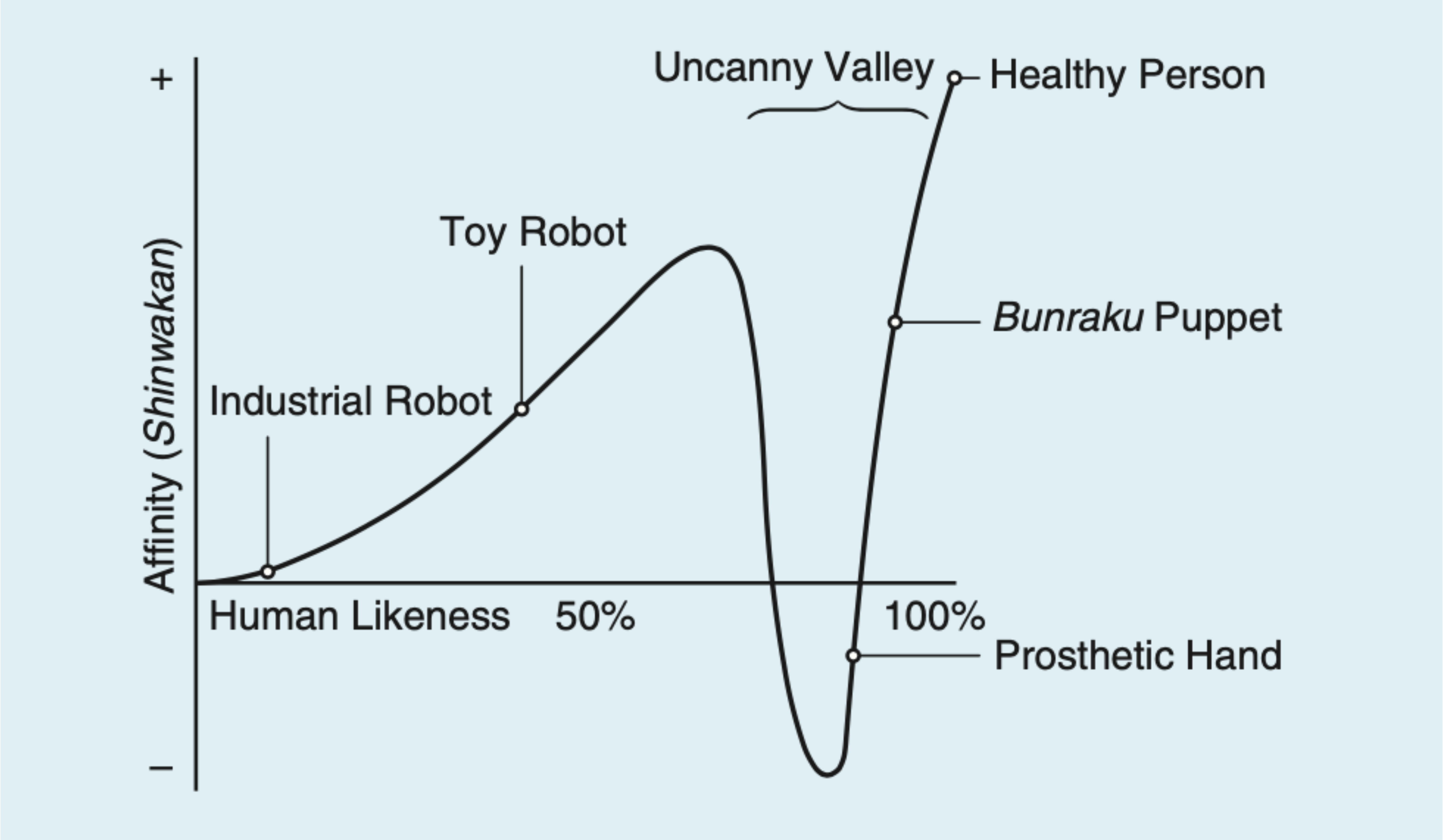
Robot Appearance - Humanlikeness

Duffy, 2003



Robot Appearance - Uncanny Valley

Mori et al., 2012



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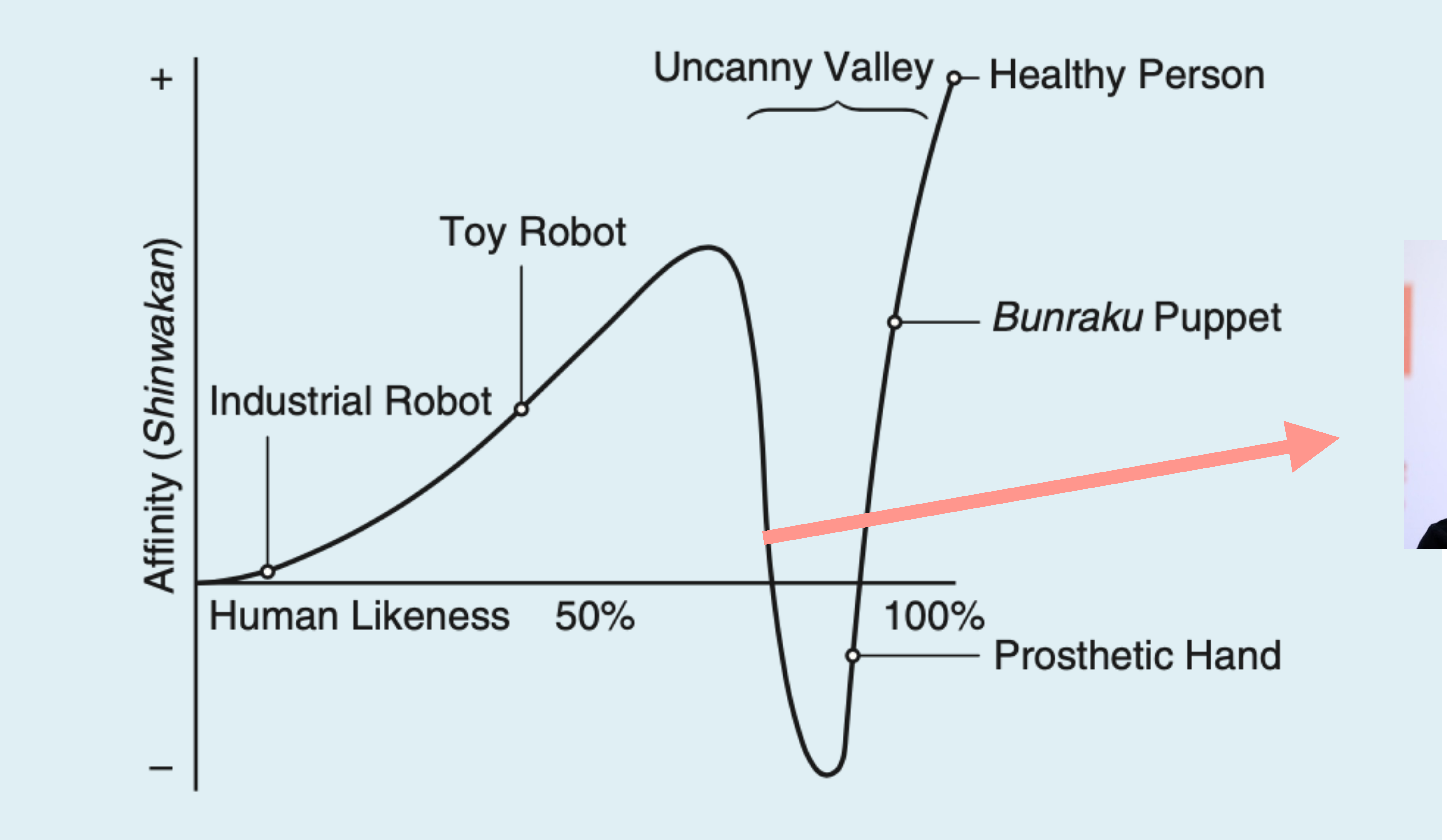

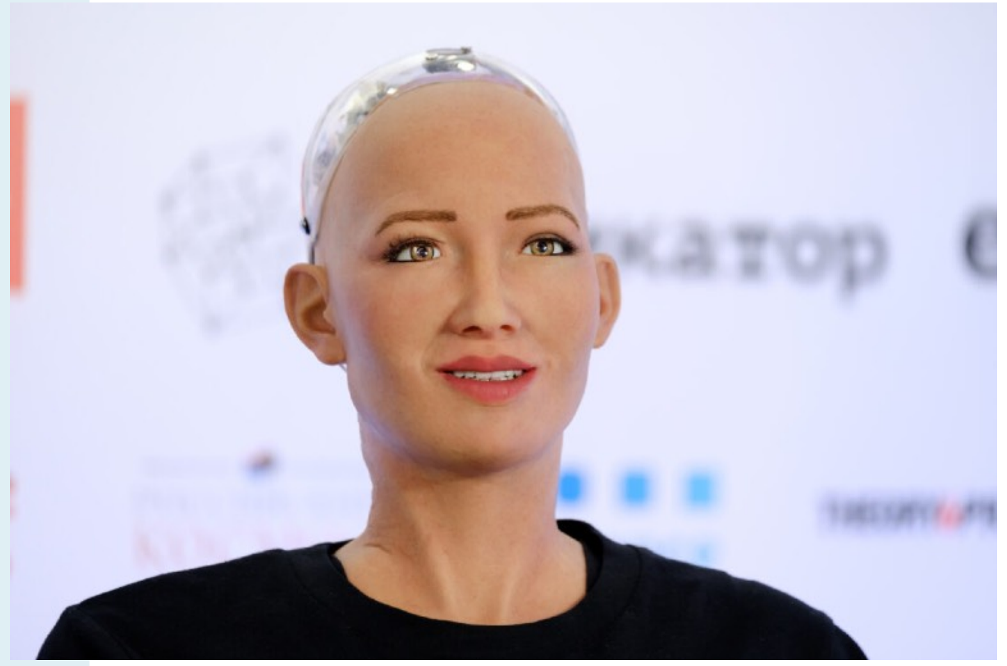

Human-Robot Interaction

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Autonomy - Sheridan’s Scale
Sheridan, 1978

1. Computer offers no assistance; human does it all
2. Computer offers a complete set of action alternatives
3. Computer narrows the selection down to a few choices
4. Computer suggests a single action
5. Computer executes that action if human approves
6. Computer allows the human limited time to veto before automatic execution
7. Computer executes automatically then necessarily informs the human
8. Computer informs human after automatic execution only if human asks
9. Computer informs human after automatic execution only if it decides to
10. Computer decides everything and acts autonomously, ignoring the human

Human-Robot Interaction

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Social Capabilities

Fong et al., 2003

According to Fong et al. a social robot can exhibit the following “human social” characteristics:

1. express and/or perceive emotions;
2. communicate with high level dialogue;
3. learn/recognise models of other agents;
4. establish/maintain social relationships;
5. use natural cues (gaze, gestures, etc.);
6. exhibit distinctive personality and character;
7. may learn/develop social competencies.

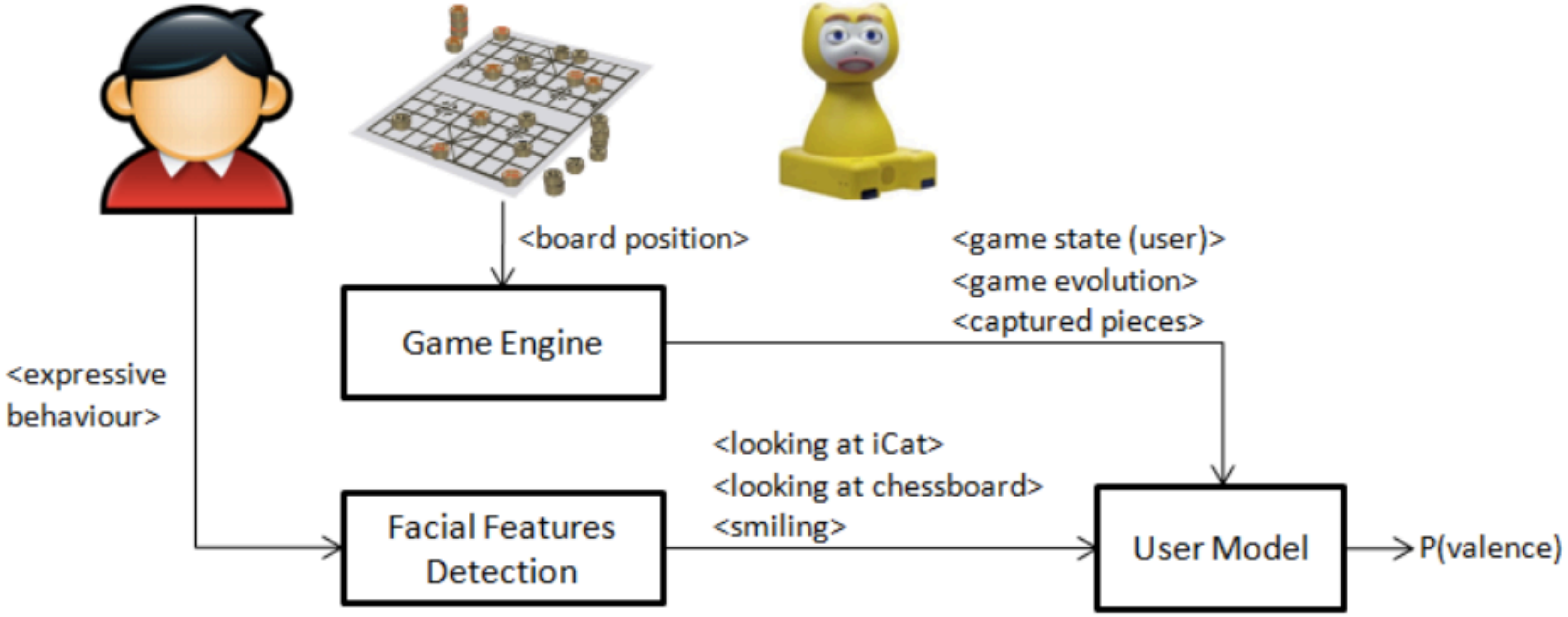
Social Capabilities

1. Express and/or perceive emotions

Leite et al., 2012

iCat the Affective Chess Player

“The results of the study suggest that children perceived the robot in both empathic versions as more engaging, helpful and also provided higher ratings in terms of self-validation.”



Social Capabilities

2. Communicate with high level dialogue

Williams & Scheutz, 2017

A reasoning component that produces human-preferred clarification requests that conform with the pragmatics of human-robot dialogue

“Our second experiment showed that the theoretical commitments of our robot architecture align with human preferences, and that the clarification requests generated by our full NLG pipeline may be comparable to human-generated clarification requests.”

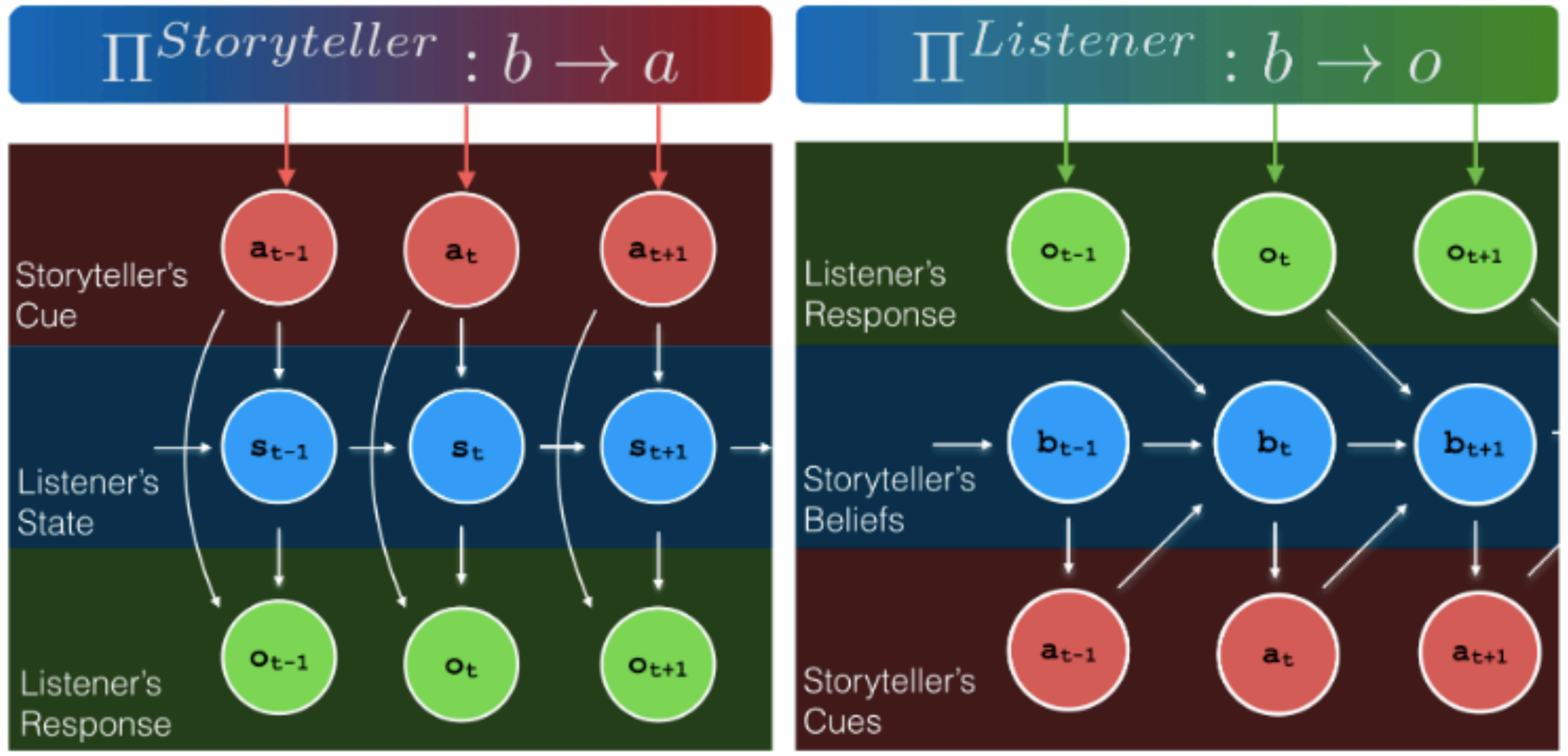
Social Capabilities

3. Learn/recognise models of other agents

Lee et al. 2019

Bayesian Theory of Mind approach to model dyadic storytelling interactions

“The role of storytellers is to influence and infer the attentive state of listeners using speaker cues, and we computationally model this as a POMDP planning problem. The role of listeners is to convey attentiveness by influencing perceptions through listener responses, which we computational model as a DBN with a myopic policy.”



(a) Intentional Inference Model (b) Belief Manipulation Model

Social Capabilities

4. Establish/maintain social relationships

Leite et al., 2013

Int J Soc Robot (2013) 5:291–308
DOI 10.1007/s12369-013-0178-y

SURVEY

Social Robots for Long-Term Interaction: A Survey

Guidelines for Future Design:

- Appearance and expectations

- Incremental Novel Behaviours

- Affective Interactions and Empathy

- Memory and Adaptation

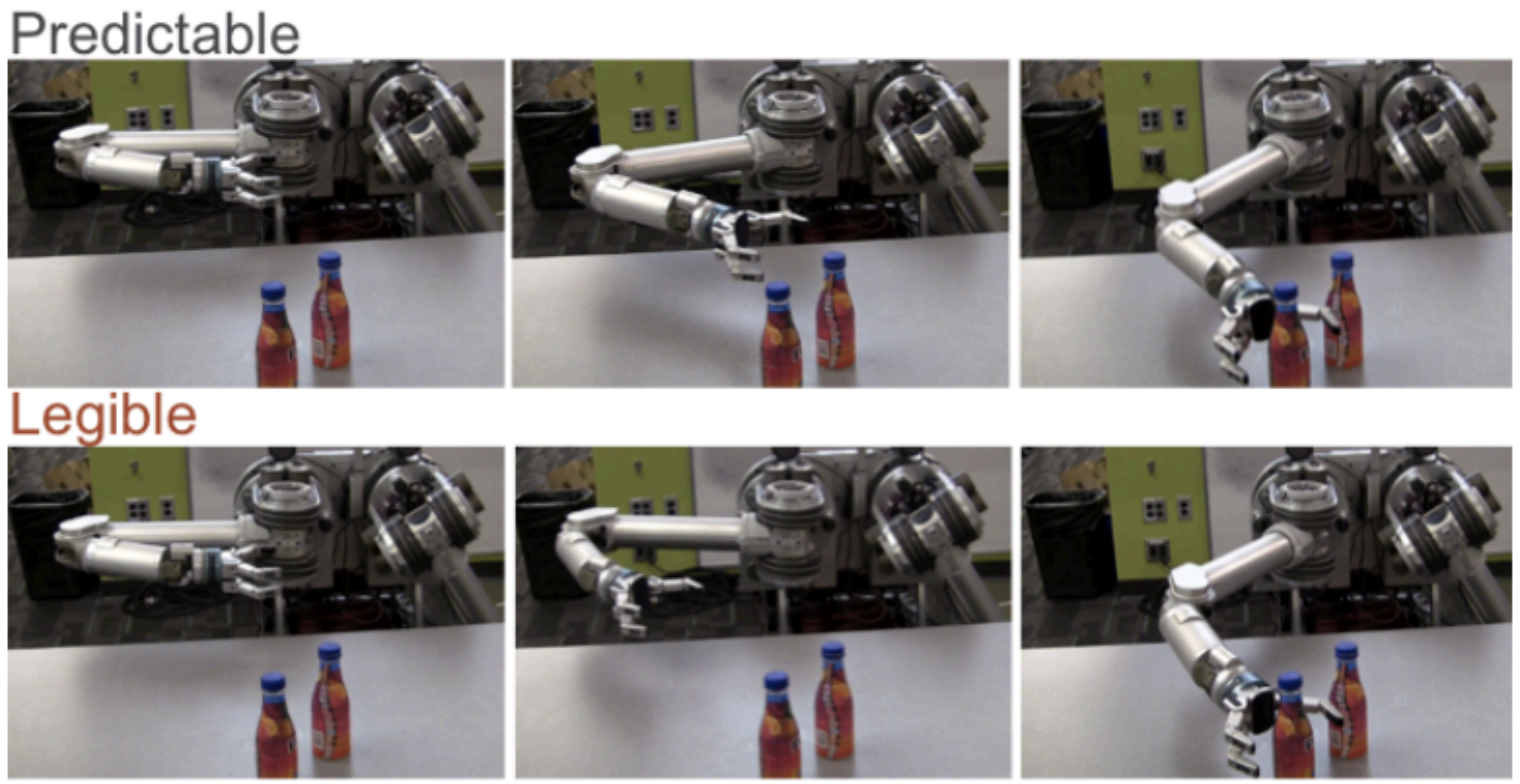
Social Capabilities

5. Use natural cues (gaze, gestures, etc.)

Dragan et al., 2013

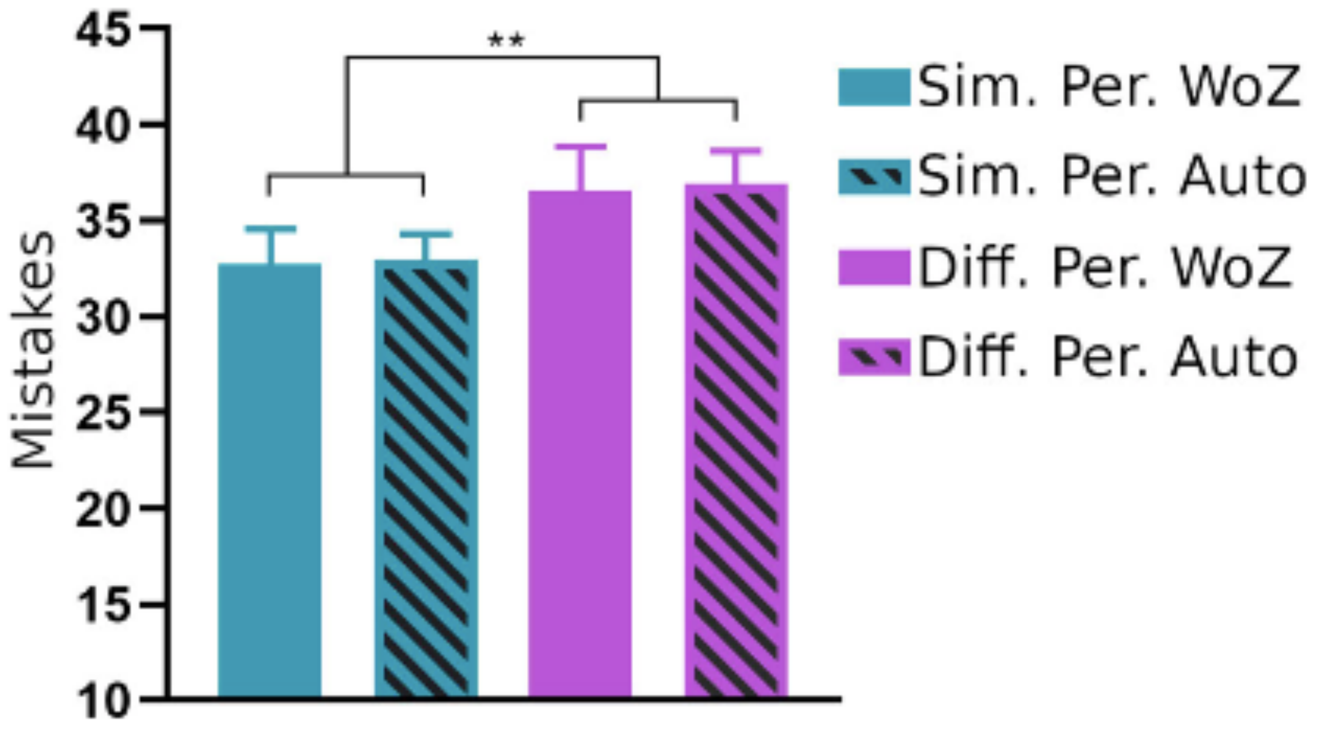
A formalism to mathematically define and distinguish predictability and legibility of motion and models to generate predictable/legible motions based on optimizing cost.

“Legible motion is motion that enables an observer to quickly and confidently infer the correct goal G. Predictable motion is motion that matches what an observer would expect, given the goal G.”



Social Capabilities

6. Exhibit distinctive personality and character



Andriella et al., 2020

Memory Game Assistive Scenario

“Our findings showed that participants were able to distinguish between robots’ personalities, and not between the level of autonomy of the robot (Wizard-of-Oz vs fully autonomous). Finally, we found that participants achieved better performance with a robot helper that had a similar personality to them, or a human helper that had a different personality.”

Social Capabilities

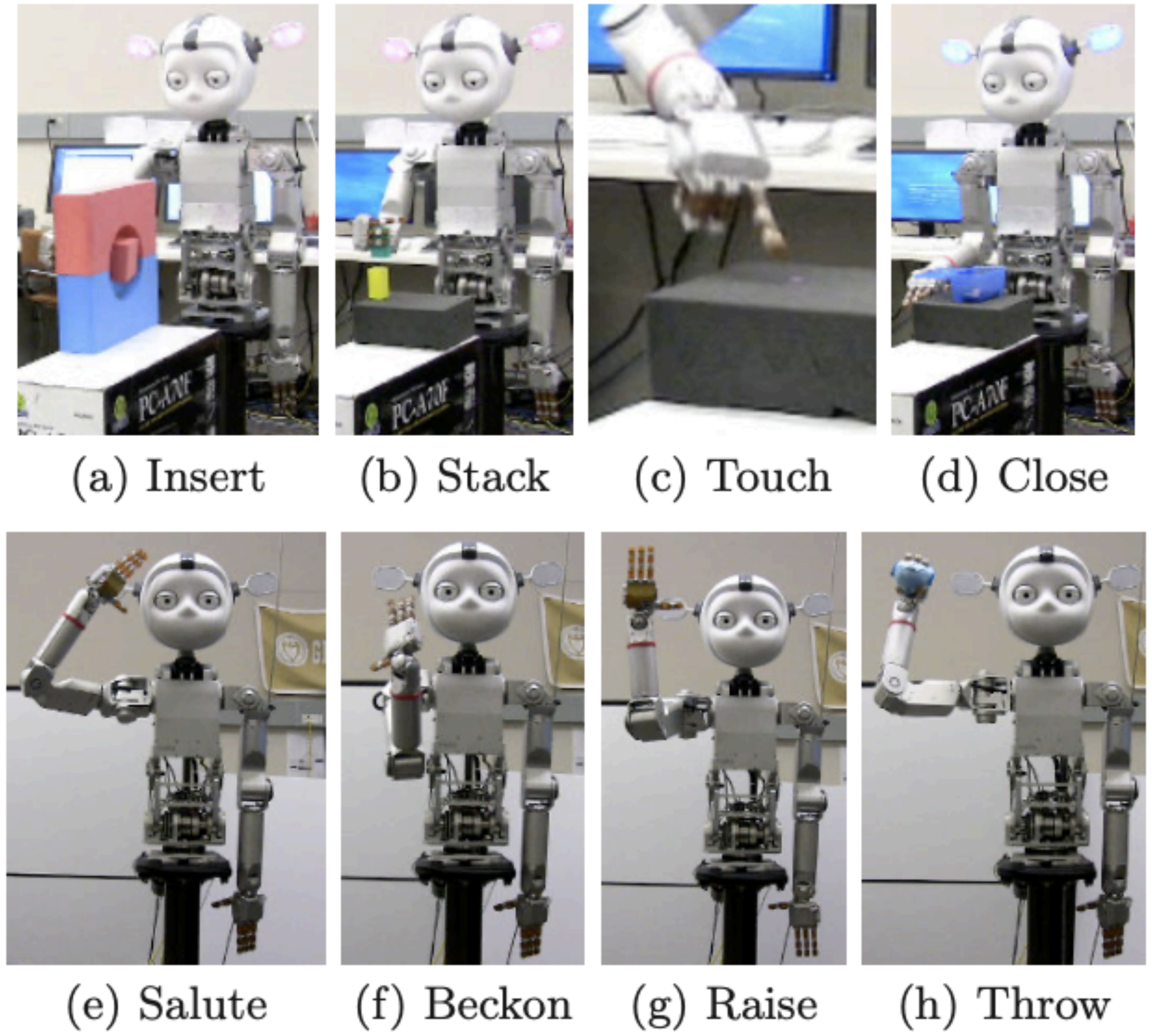
7. May learn/develop social competencies

Akgun et al., 2012

Learning by Demonstration

The paper explores three demonstration approaches. Human teachers can demonstrate skills to the robot in three different ways: trajectory demonstrations, keyframe demonstrations, and keyframe iterations.

“Finally, based on these observations, we introduced a hybrid mode of interaction in which the user can chain together keyframe and trajectory segments.”

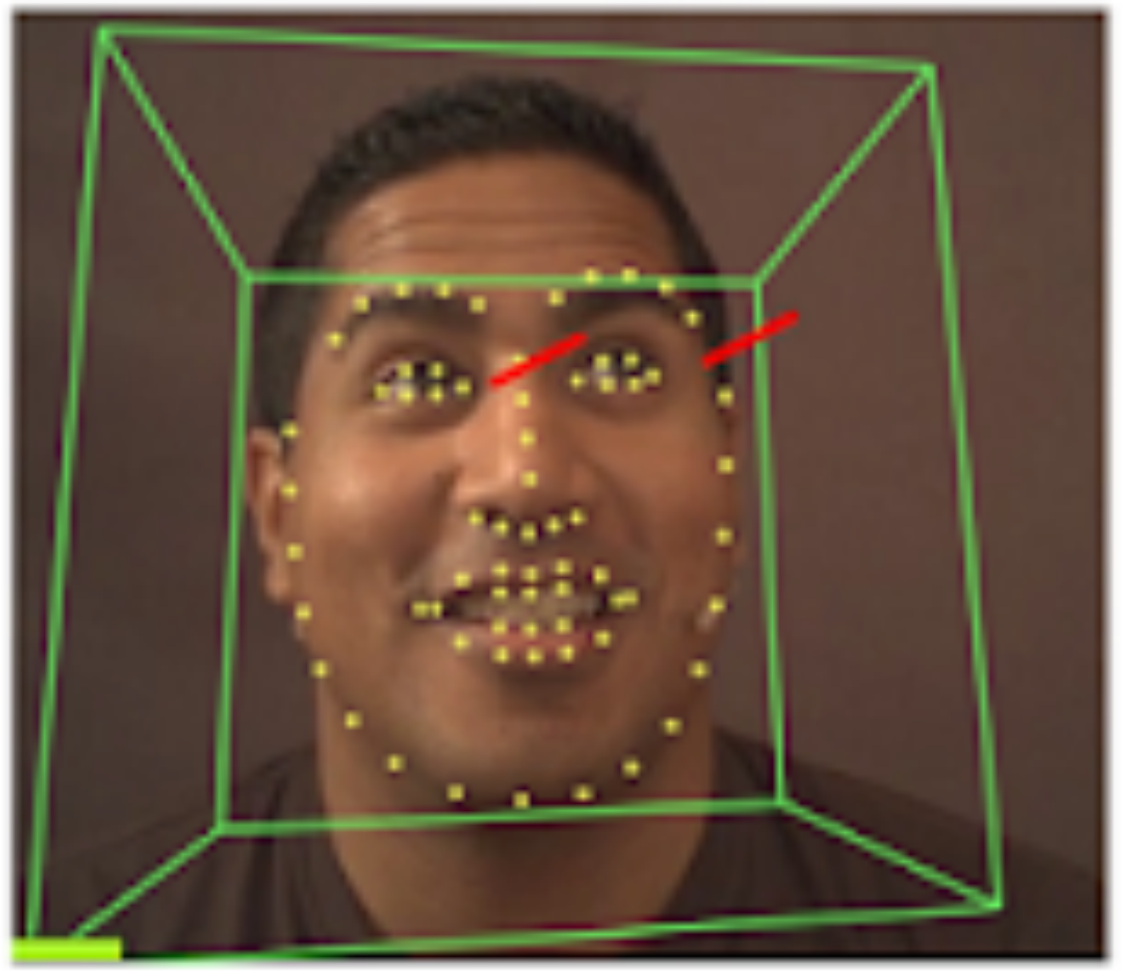


(a) Insert (b) Stack (c) Touch (d) Close

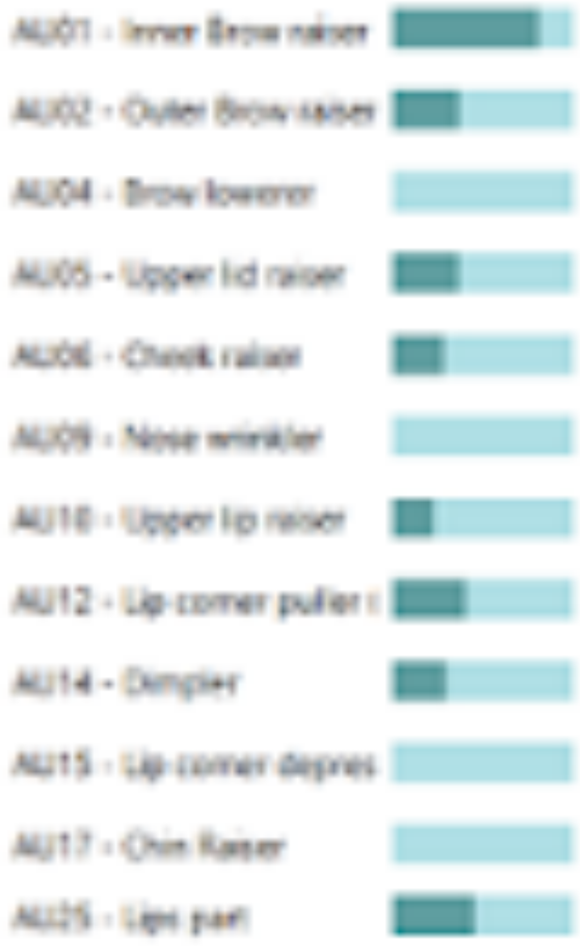
(e) Salute (f) Beckon (g) Raise (h) Throw

What are my research goals?

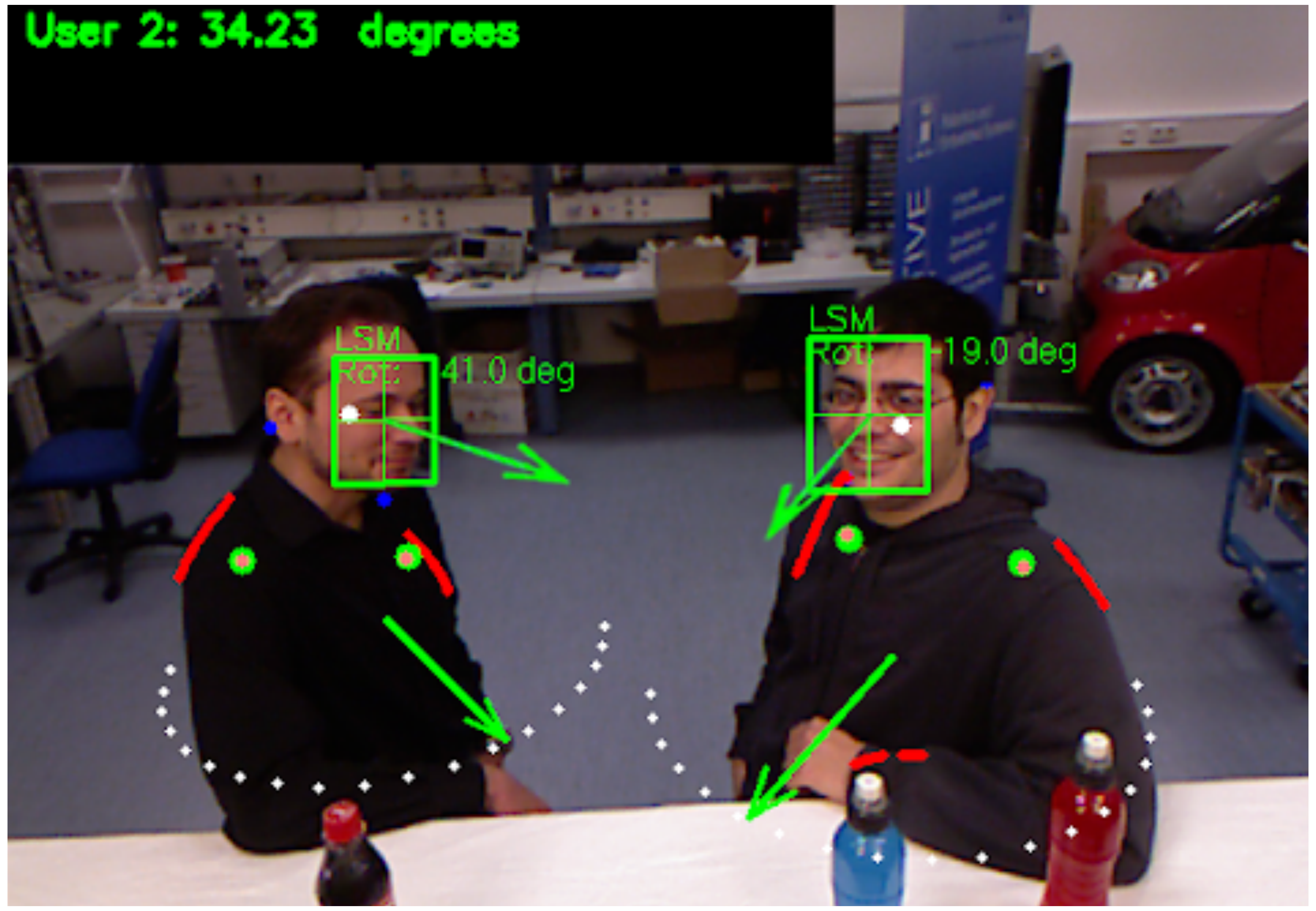
Facial Appearance

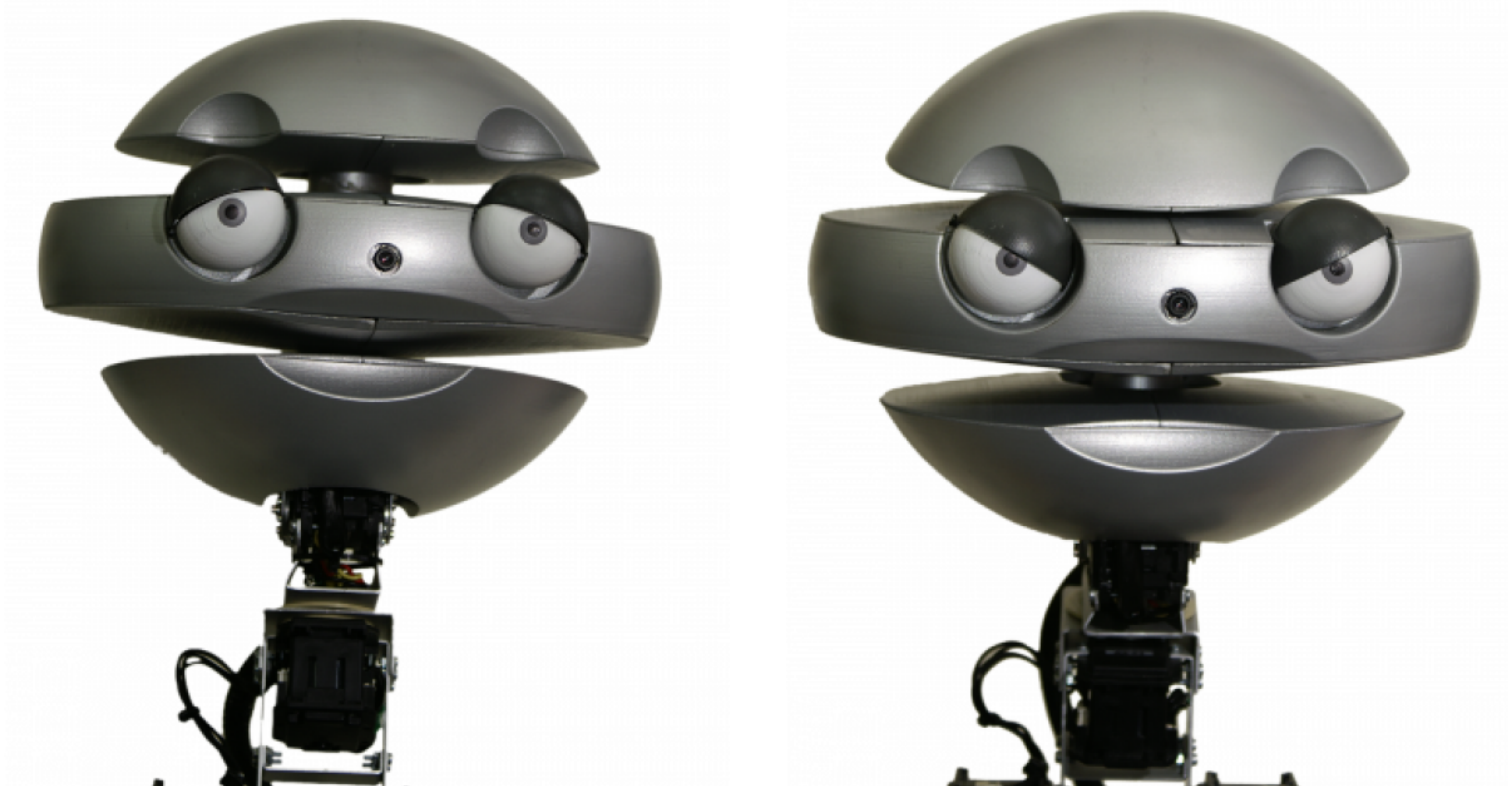


Facial Landmarks, head pose, and eye gaze



Facial Action Units





My work is mostly related to robotic teammates and group interactions

Example 1: Robot that plays *“Sueca”*


YouTube
Building a social robot as a game companion in a card game
Filipa Correia, Tiago Ribeiro, Patrícia Alves-Oliveira, Nuno Maia,
Francisco Melo and Ana Paiva
INESC-ID & Instituto Superior Técnico
Lisbon, Portugal
ACM/IEEE Human-Robot Interaction 2016 Videos
March 7-10, 2016
New Zealand
inesc id
lisboa
PArCEIRO
gaips
TÉCNICO
LISBOA
FCT

How can we create a robot that plays “*Sueca*”?

1. Research state-of-the-art algorithms to solve similar card games

2. Program the module that plays the card game (“bot”)


3. Observe the people’s behaviours
while playing the game

E35 <gaze(player1)> Uma vitória para a equipa azul! <animate(joy1)>

	A	B	C	D	
25	24	SessionEnd:DRAW	FALSE	Undefined	<gaze(player1)><animate(surprise2)> Temos um empate. Bem, <glance(player0)> agora
26	25	SessionEnd:DRAW	FALSE	Undefined	<gaze(player1)> Pelo menos é melhor do que perder. Bem, <glance(player0)> agora vou
27	26	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Ufa, foi por pouco... <animate(joy1)>
28	27	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Não estava à espera, mas lá conseguimos ganhar! <animate(joy1)>
29	28	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Não ganhámos por muito, mas ganhámos. <animate(joy1)>
30	29	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Desta vez parece que ganhámos... <animate(joy1)>
31	30	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Ora bem, mais uma vitória para nós. <animate(joy1)>
32	31	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Colega, estamos fortes! <animate(joy1)>
33	32	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Há que continuar assim... <animate(joy1)>
34	33	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Colega, mantém a tática. Está a resultar! <animate(joy1)>
35	34	GameEnd:SINGLE_WIN	FALSE	Undefined	<gaze(player1)> Uma vitória para a equipa azul! <animate(joy1)>
36	35	GameEnd:SINGLE_LOST	FALSE	Undefined	<gaze(player0)> Já estava à espera... <gaze(player2)> <animate(anger1)>
42	41	GameEnd:DOUBLE_WIN	FALSE	Undefined	<gaze(player1)> Ora bem, mais duas vitórias para nós. <animate(joy1)>
43	42	GameEnd:DOUBLE_WIN	FALSE	Undefined	<gaze(player1)> Colega, estamos fortes! <animate(joy1)>

4. Write the script of speeches and emotional behaviours for the robot to use during the game

5. Program the module that performs social behaviours

Example 2: Exploring a research question

Does the opinion about a robotic teammate change if our team wins or loses the game?

- 1 person and 2 robots form a team

- 1 person and 2 robots form a team
- “public-goods game”

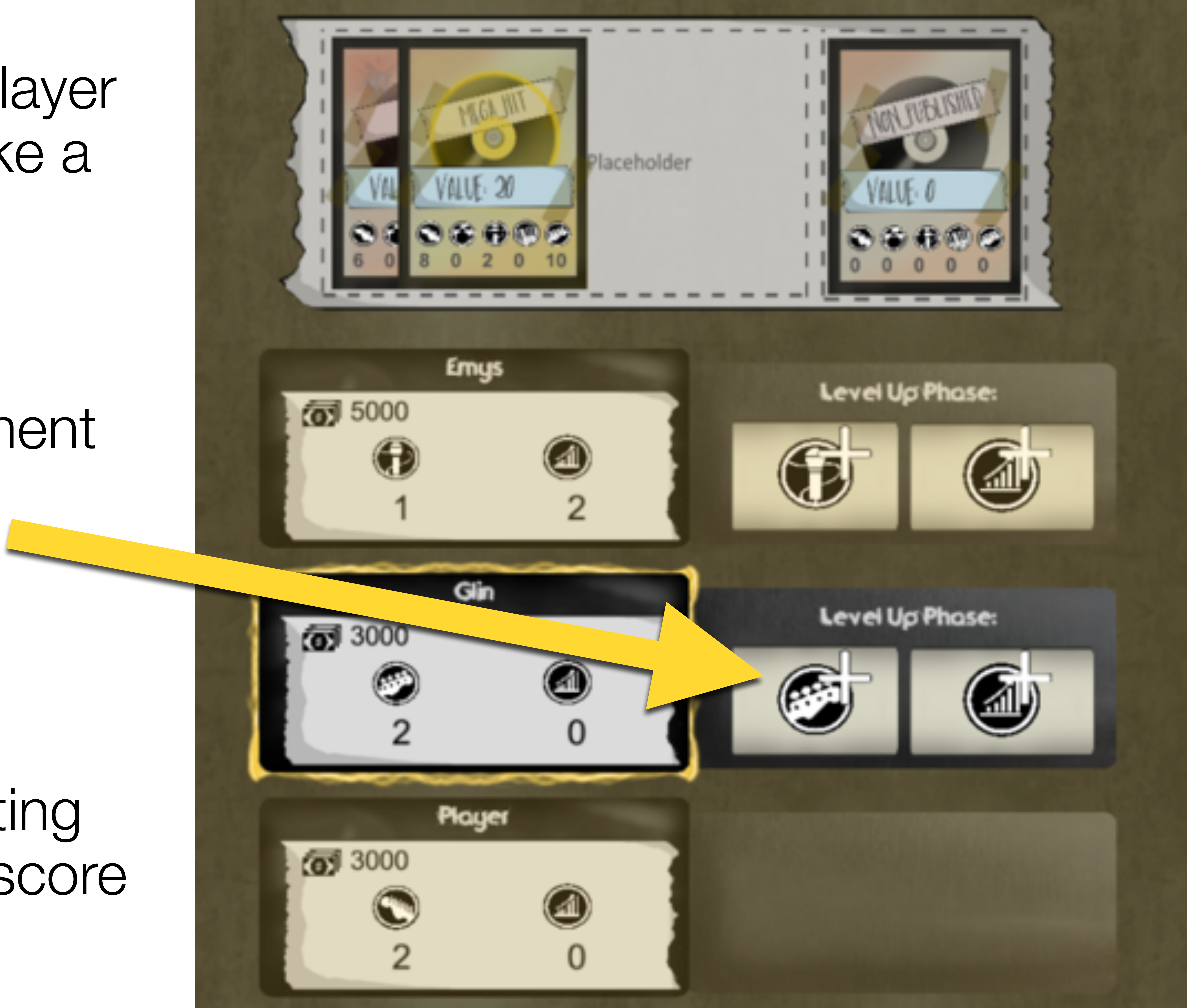
- 1 person and 2 robots form a team
- “public-goods game”
- Used by economists to study cooperation among countries, for instance, in problems of climate change/agreements

- 1 person and 2 robots form a team
- “public-goods game”
- Used by economists to study cooperation among countries, for instance, in problems of climate change/agreements
- We used a musical metaphor to mask the true game

In each round, each player has to individually make a choice:

A) invest in the instrument to favor the team

B) invest in the marketing to favor his individual score



In each round, each player has to individually make a choice:

A) invest in the instrument to favor the team

B) invest in the marketing to favor his individual score

Emys

Defector

“Selfish robot”

Invests always in marketing

Glin

Cooperator

“Prosocial robot”

Invests always in the instrument

A Public Goods Game For Exploring Human-Robot Collaboration

AAMAS'19 - Demos Track

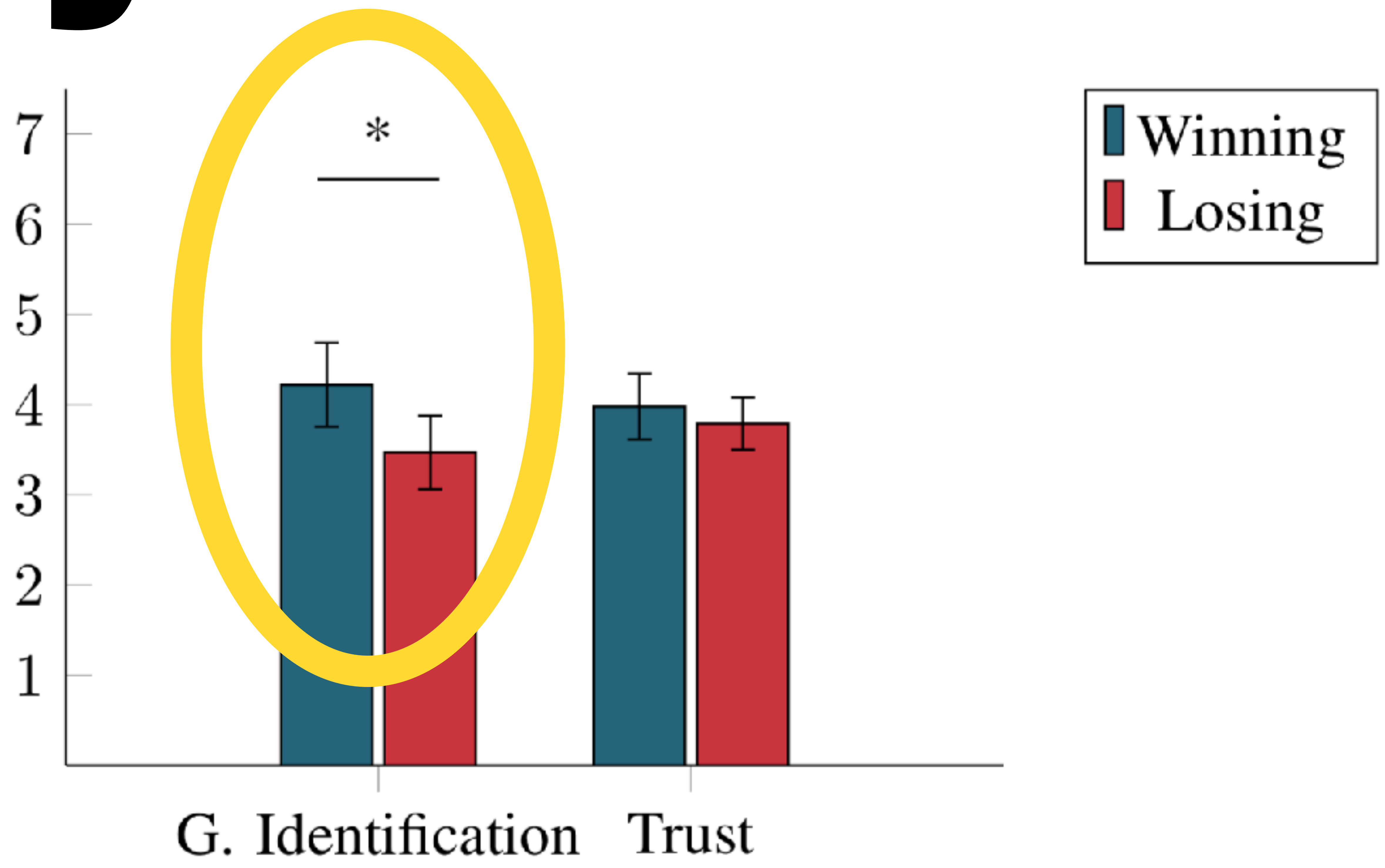
Filipa Correia, Samuel Mascarenhas, Samuel Gomes, Silvia Tulli, Fernando P. Santos, Francisco C. Santos, Rui Prada, Francisco S. Melo, Ana Paiva

Does the opinion about a robotic teammate change if our team wins or loses the game?

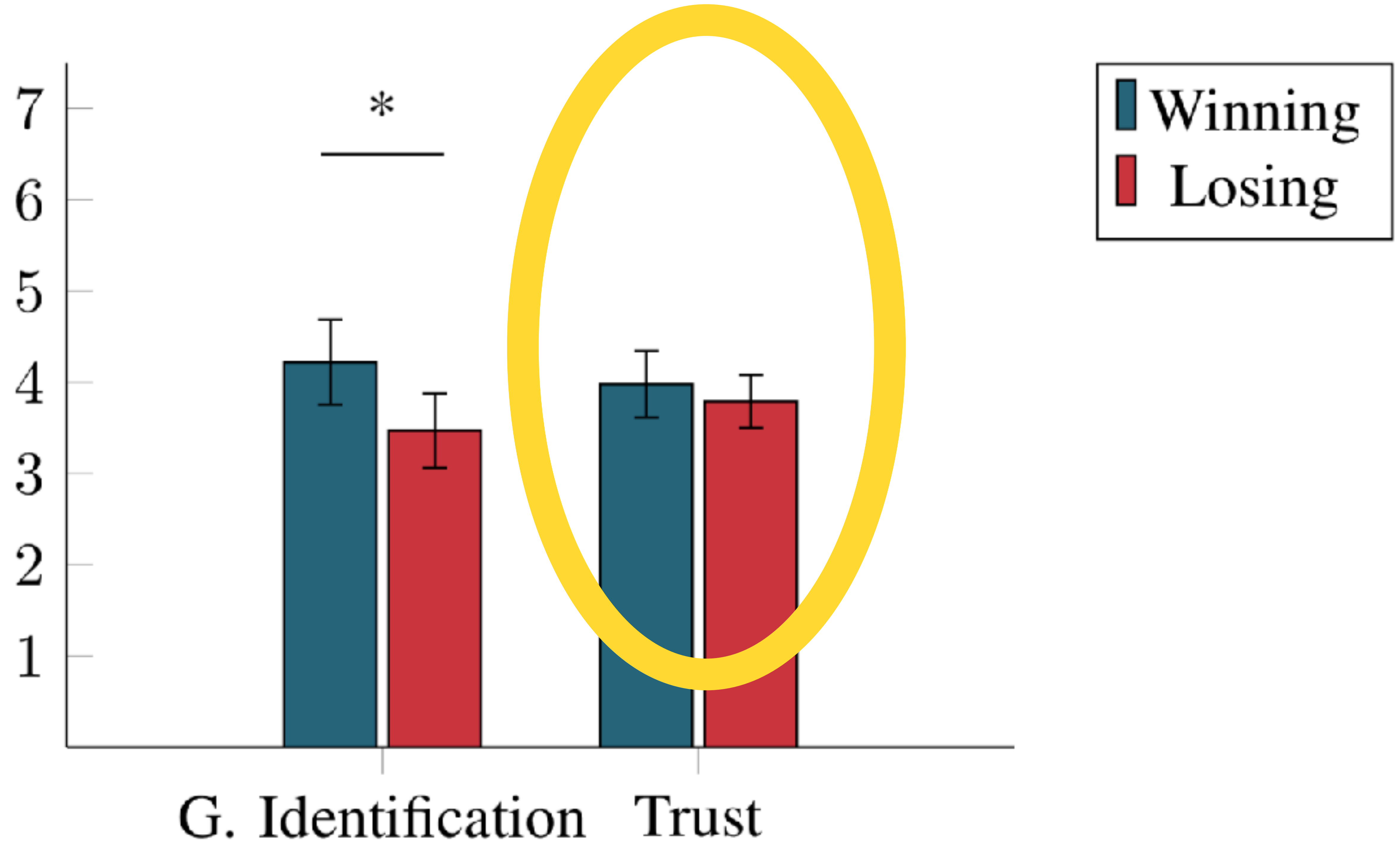
Experimental Study

- 70 people
    - 35 won the game
    - 35 lost the game
- In the end, people answered to a questionnaire about the robots and about the game

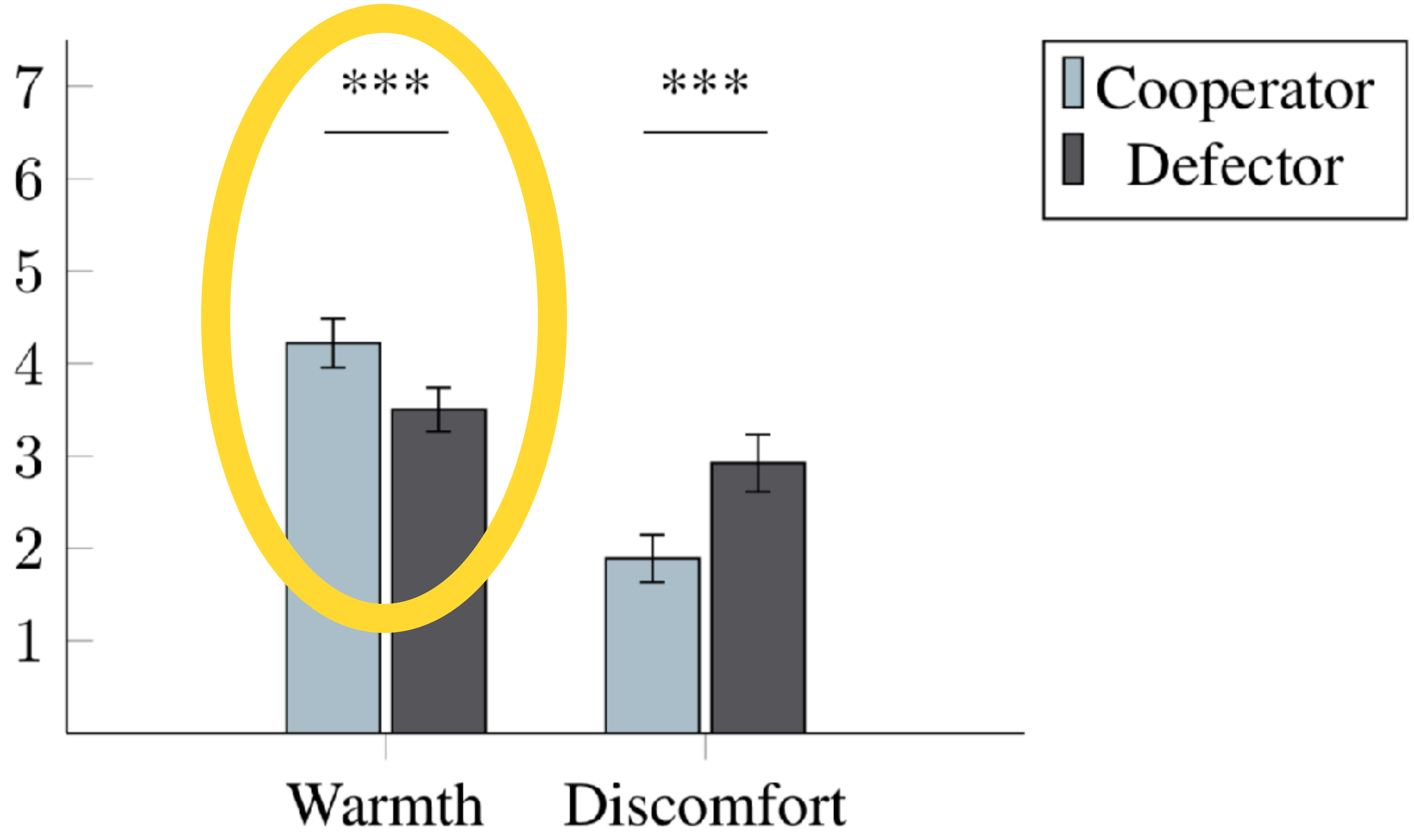
Do you identify with your team?



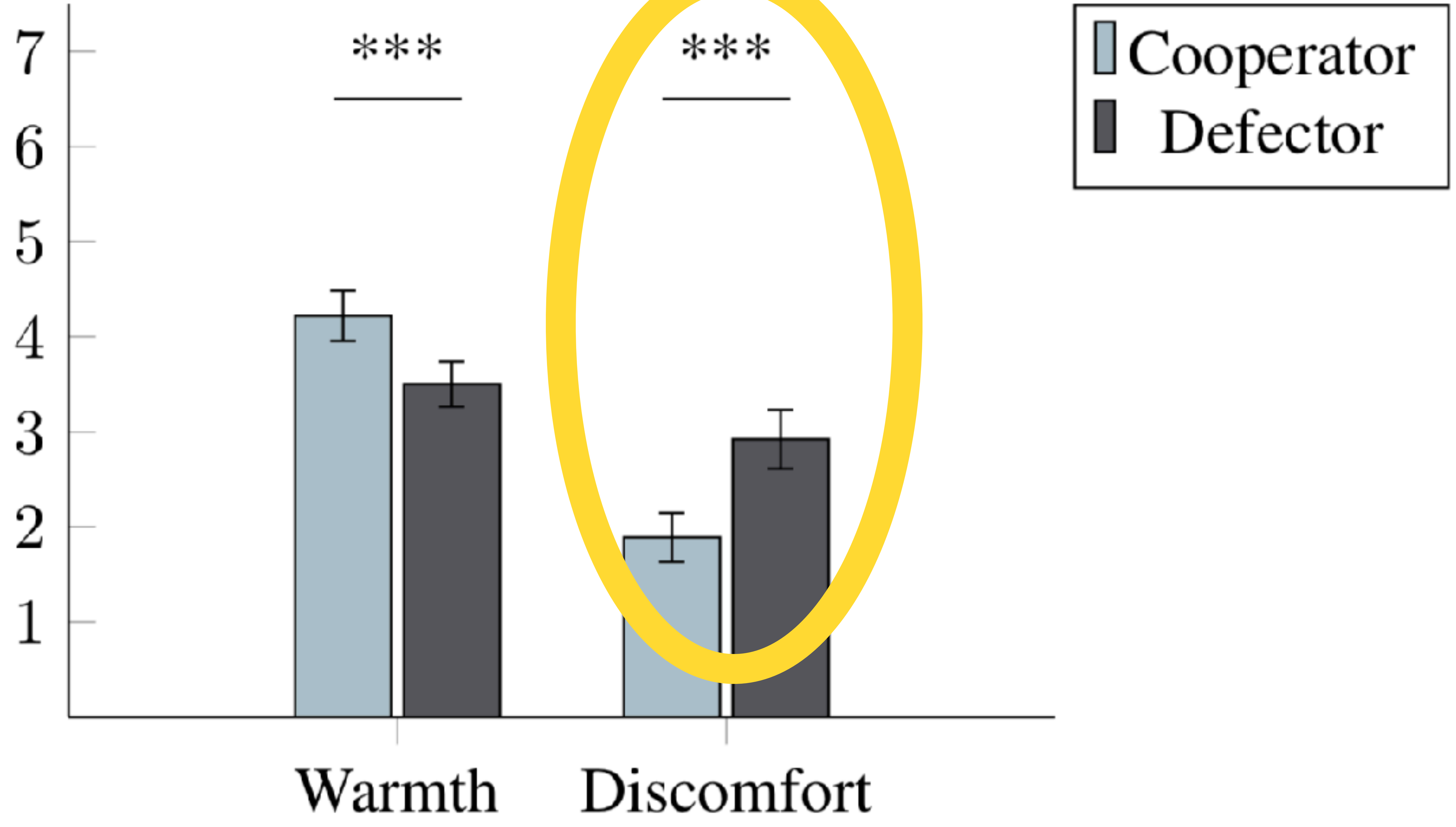
Do you trust your team?



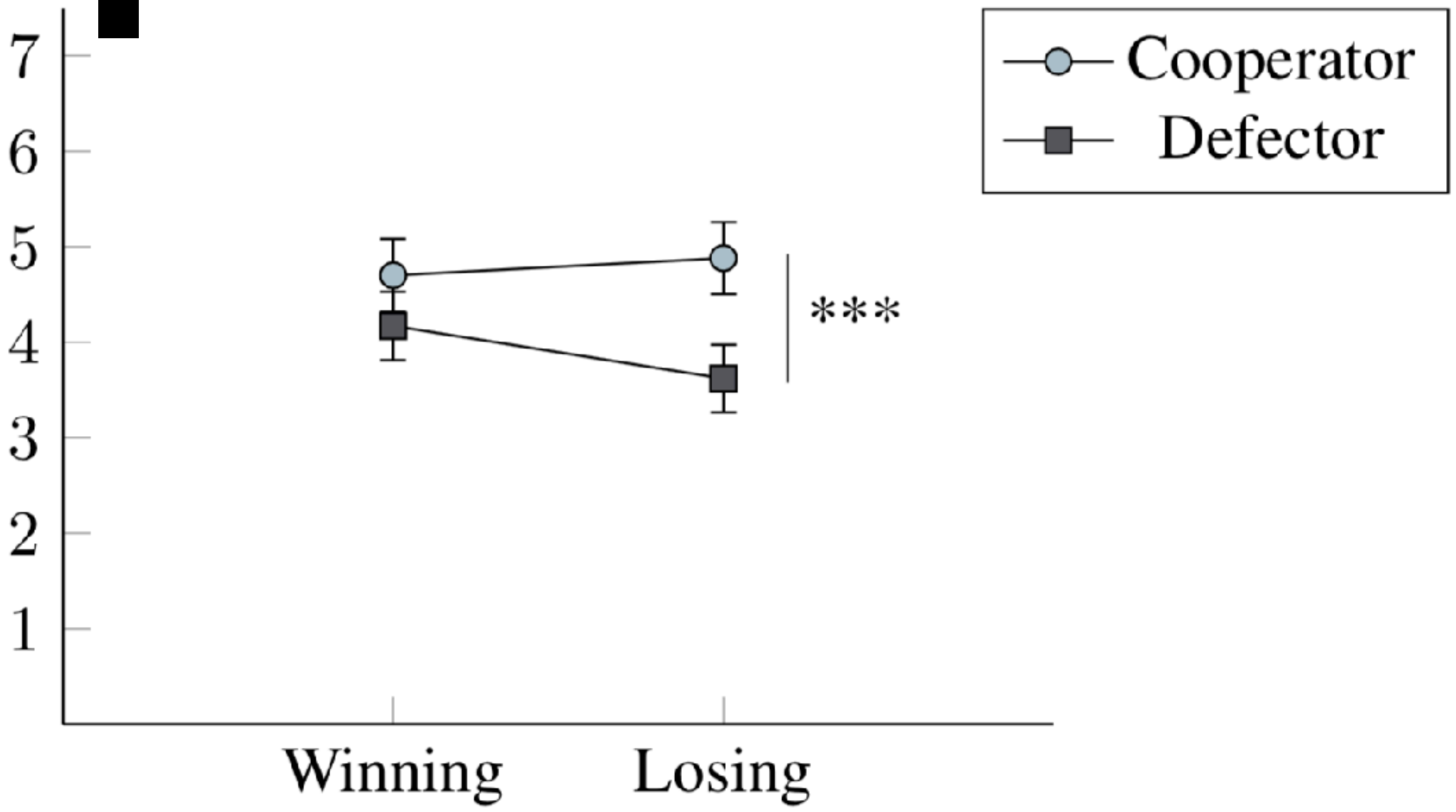
Are these robots nice?



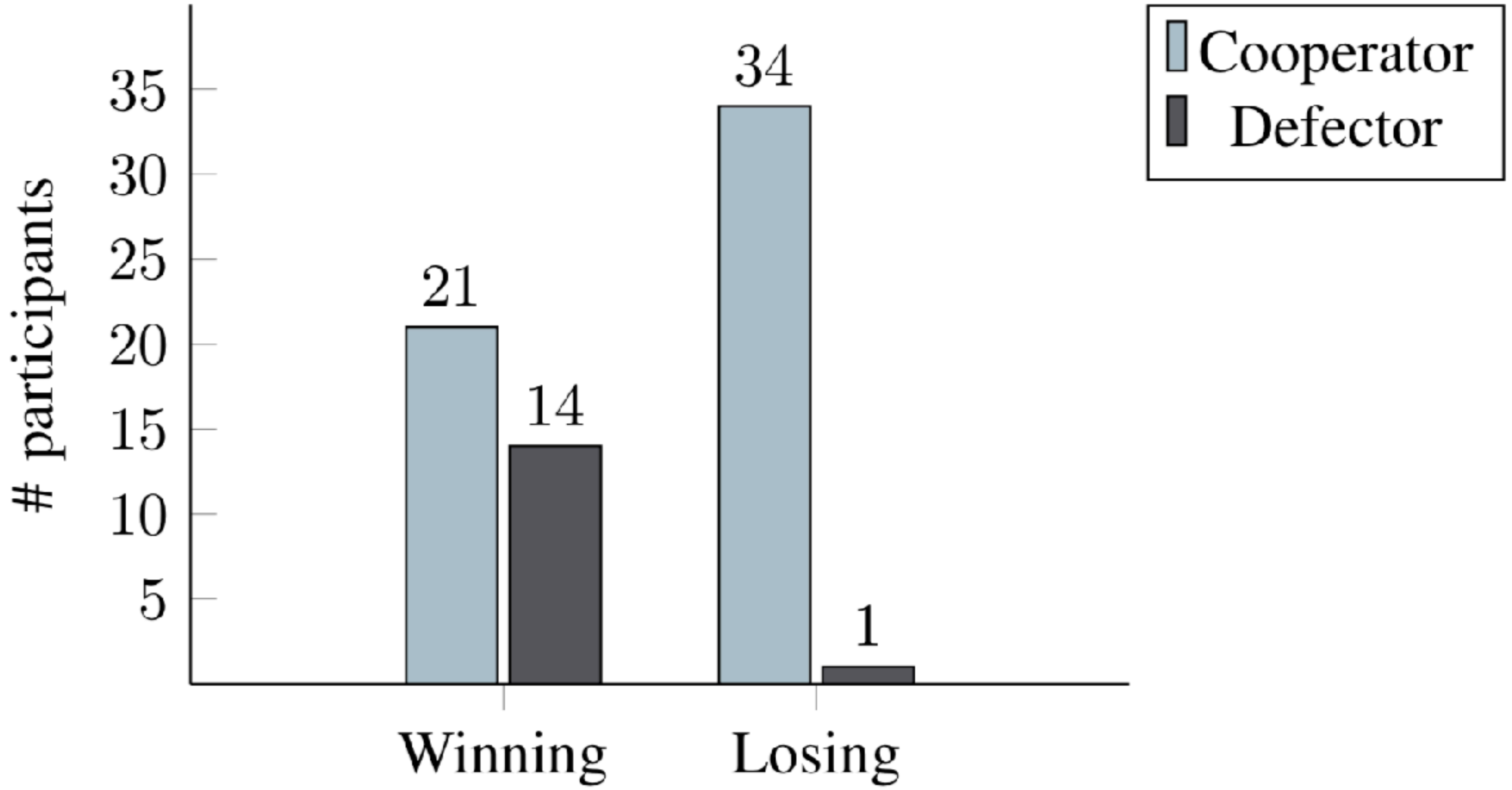
Are these robots unpleasant?



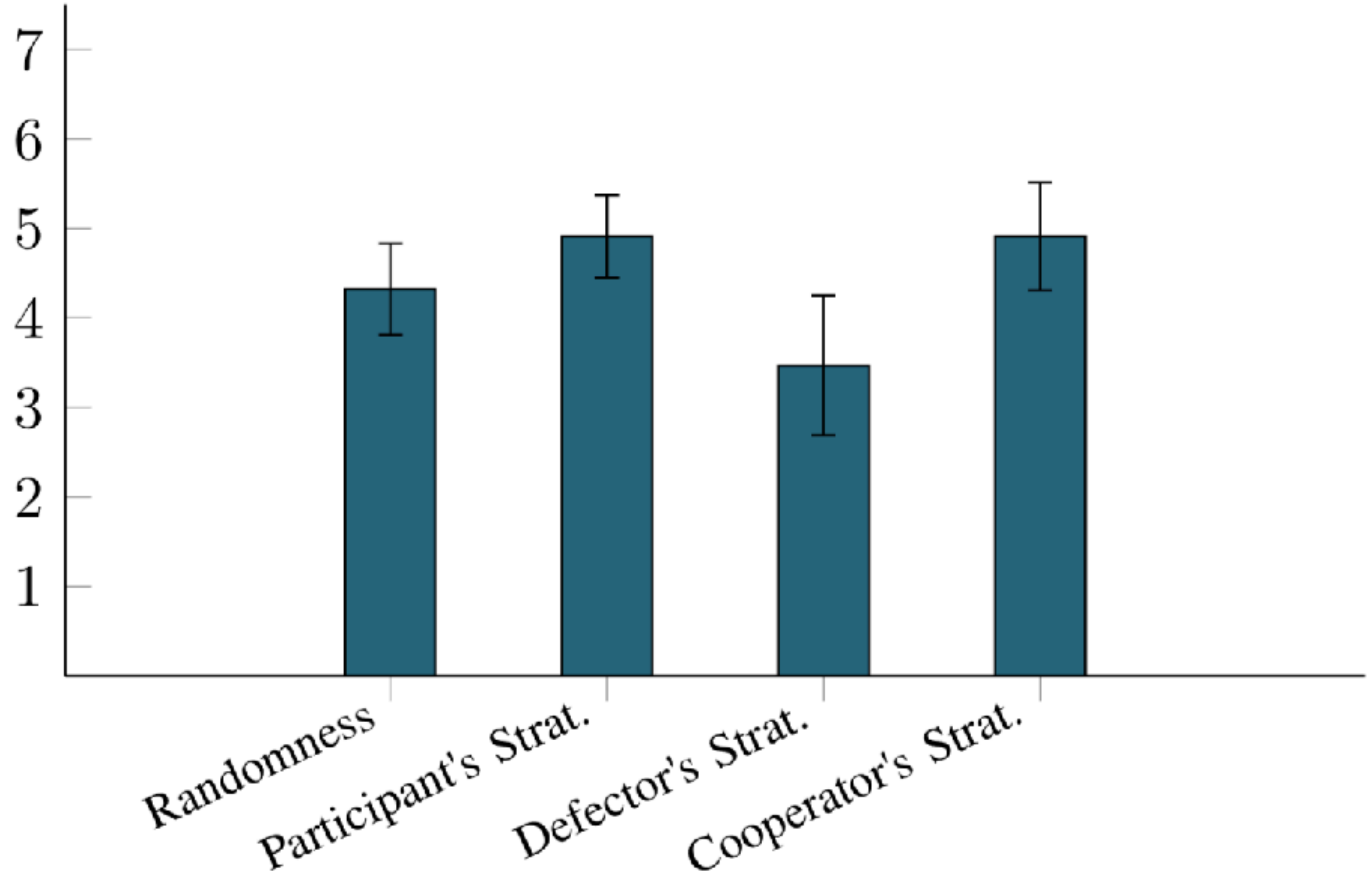
Are these robots competent?



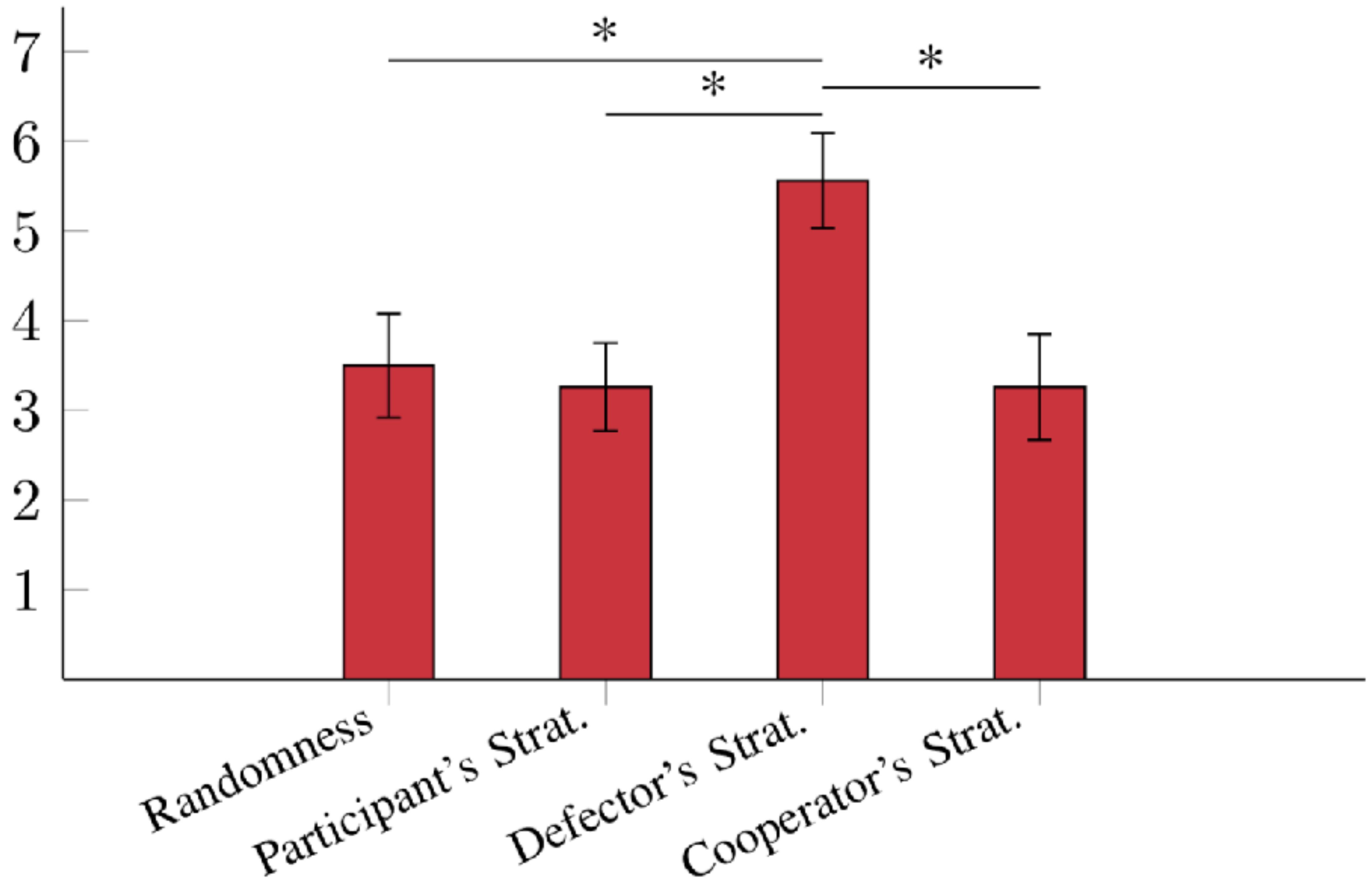
Which robot do you prefer?



Winning condition: whose credit is it?



Losing condition: whose blame is it?



Participants that won the game reported a significantly higher agreement with the sentence

...

compared to participants that lost the game.

Participants that won the game reported a significantly higher agreement with the sentence "Social robots will be relevant to the society", compared to **participants that lost the game**.

Does the opinion about a robotic teammate change if our team wins or loses the game?

Does the opinion about a robotic teamma[...]nge if our team [...] or loses the game?

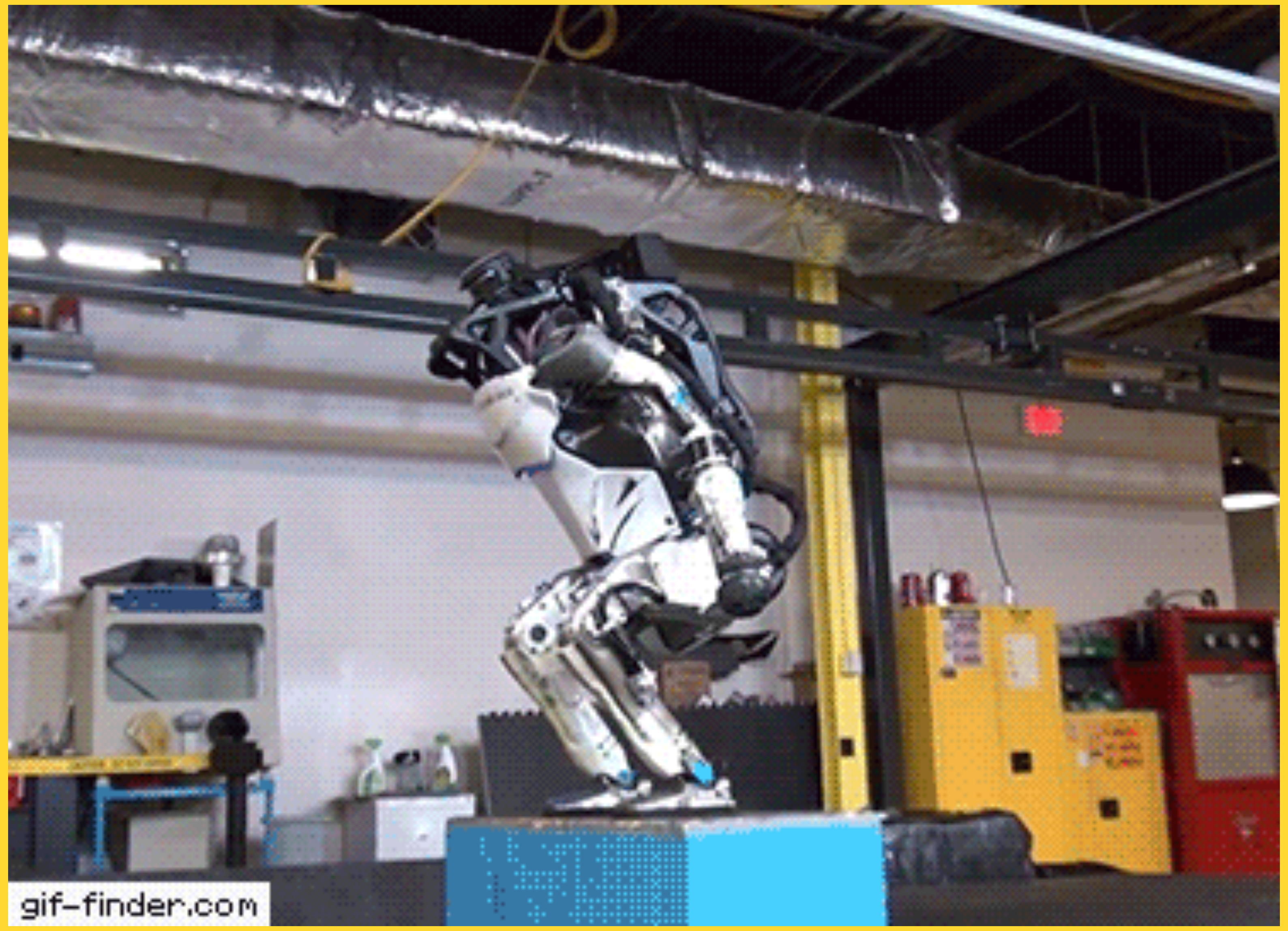
Yes!

Beyond the main research question:

Beyond the main research question: Winning masked the selfish robot!!!

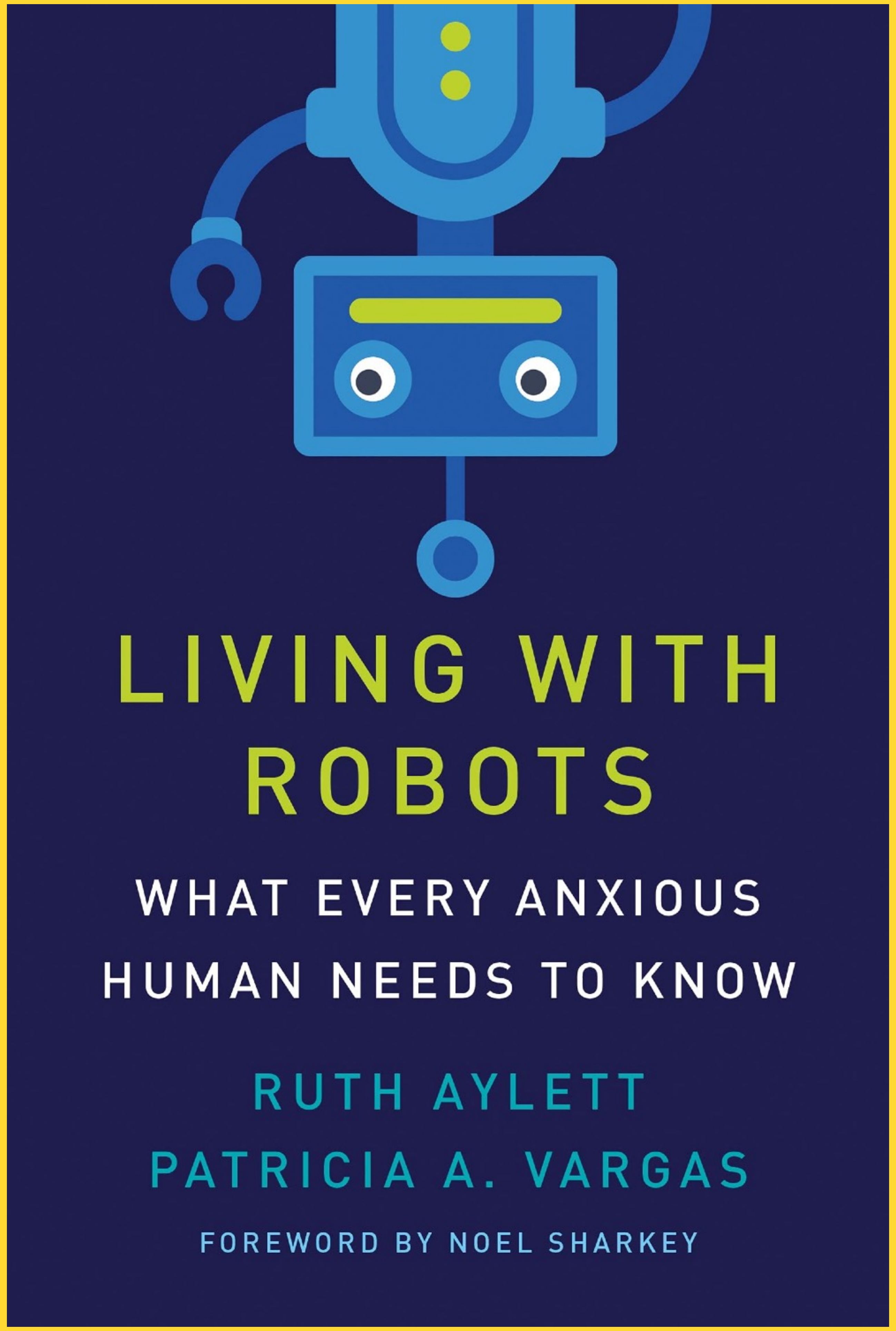
There is still a long path to walk until robots can be effective collaborators…

Don’t get deceived by what you see…



Don’t get [redacted] by what [redacted] see…

Read about it!



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Questions?

Filipa Correia

We may also get in touch later:

filipacorreia@tecnico.ulisboa.pt

@PipzCorreiaz