

Lecture 2

“I am social robot.”

Dimensions of social robot design

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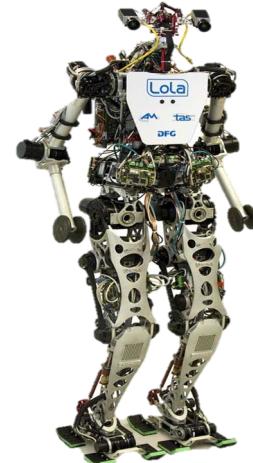
Learning objectives

By the end of this lecture, you should be able to:

- 1 – Identify relevant dimensions that characterize social robots
- 2 – Critically discuss how these dimensions affect the human-robot interaction
- 3 – Identify technical challenges associated with choices on some of these dimensions
- 4 – Apply these dimensions to the brainstorming phase of a social robot design process

What comes to mind when you hear “social robot”?

“Social” robots?



Is this a social robot?



Is this a social robot?



Is this a social robot?





<https://emalliaraki.com/social-drones>

Defining “social robots”

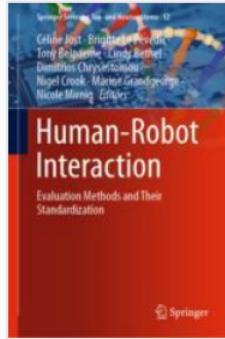
No strict (binary) definition → Think about **levels** of “socialness”

Appearance and **behavior** both play a role and should go hand in hand



In this lecture: “broad” understanding of social robots as being socially interactive

Design space for socially interactive robots



[Human-Robot Interaction](#) pp 21-64 | [Cite as](#)

An Extended Framework for Characterizing Social Robots

Authors

Authors and affiliations

Kim Baraka , Patrícia Alves-Oliveira , Tiago Ribeiro

What are some important factors (dimensions) to think about when designing robots that interact with people?

CONTEXT

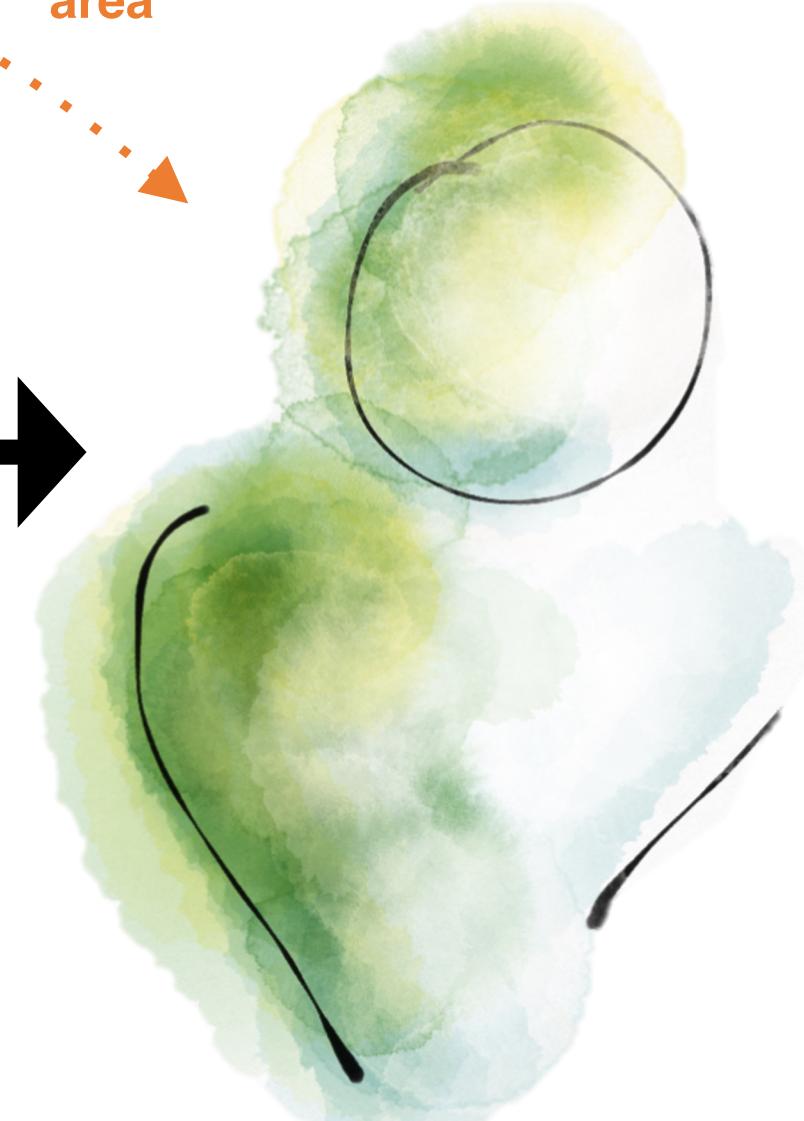


**Appearance
Social capabilities
Autonomy and intelligence**

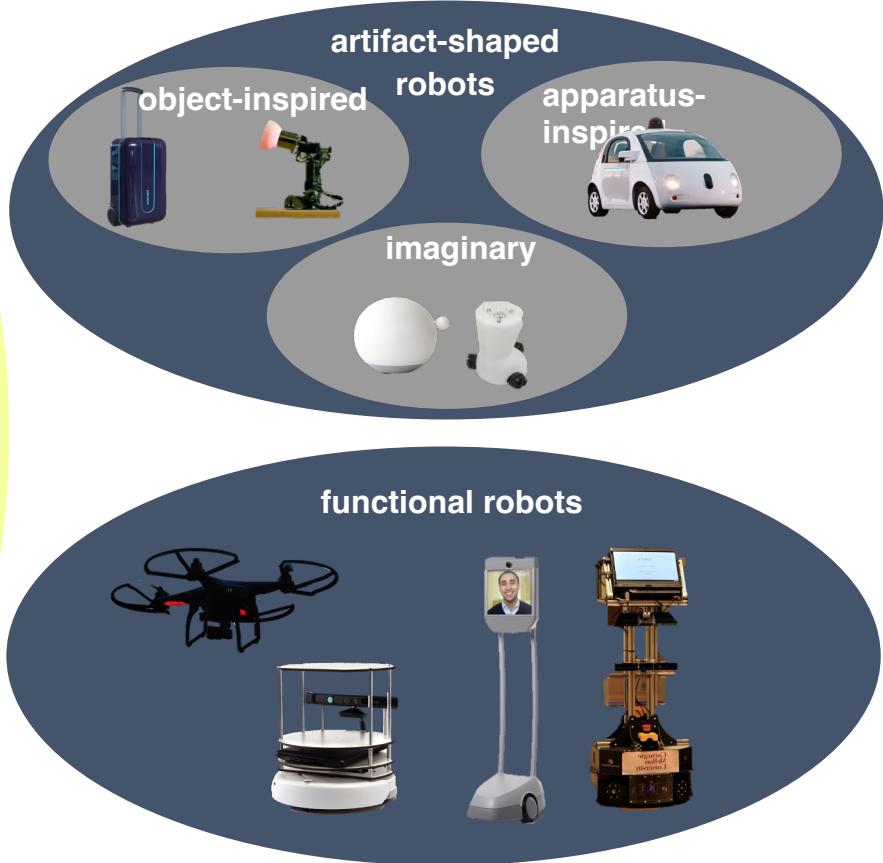
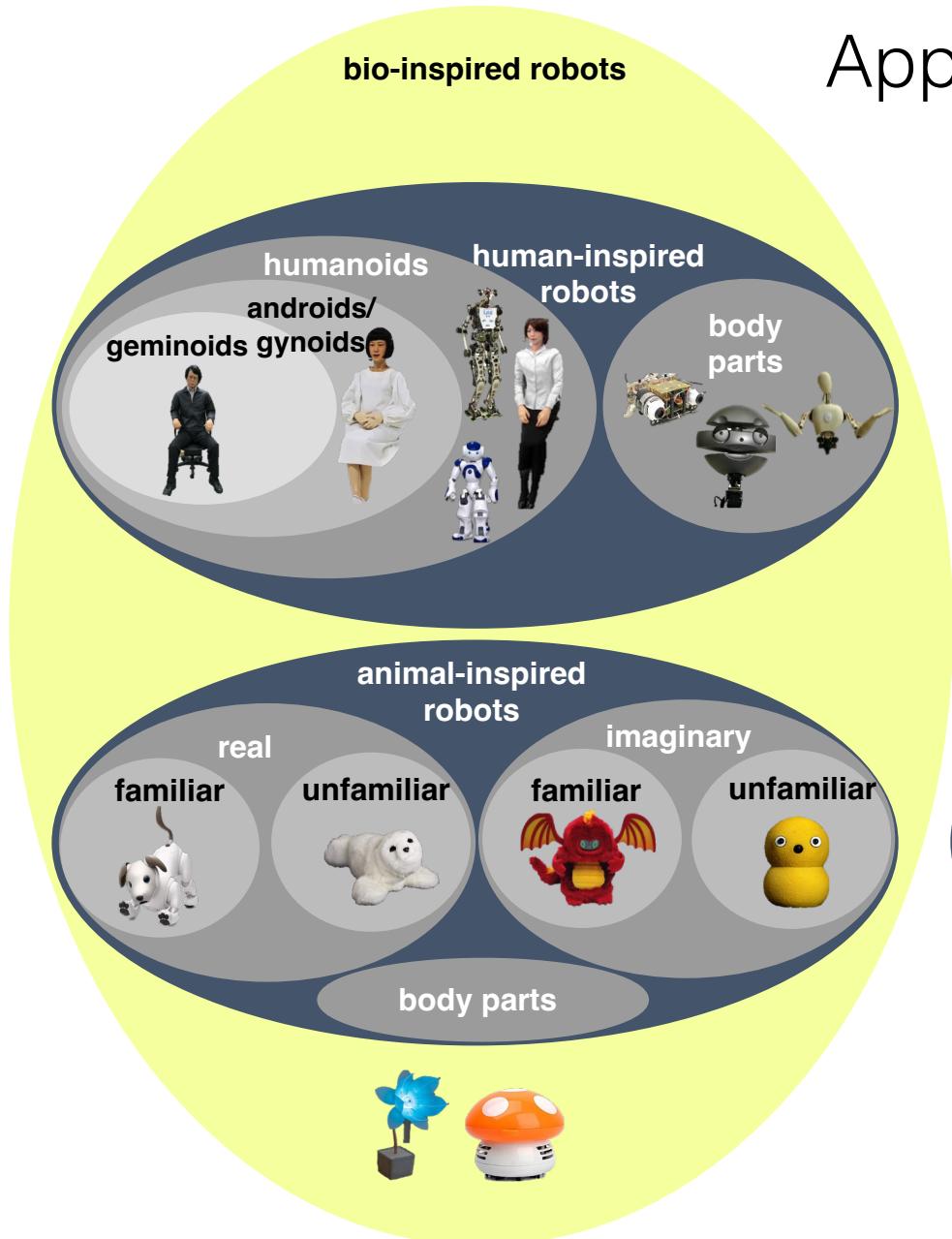
Relational role

Purpose and application area

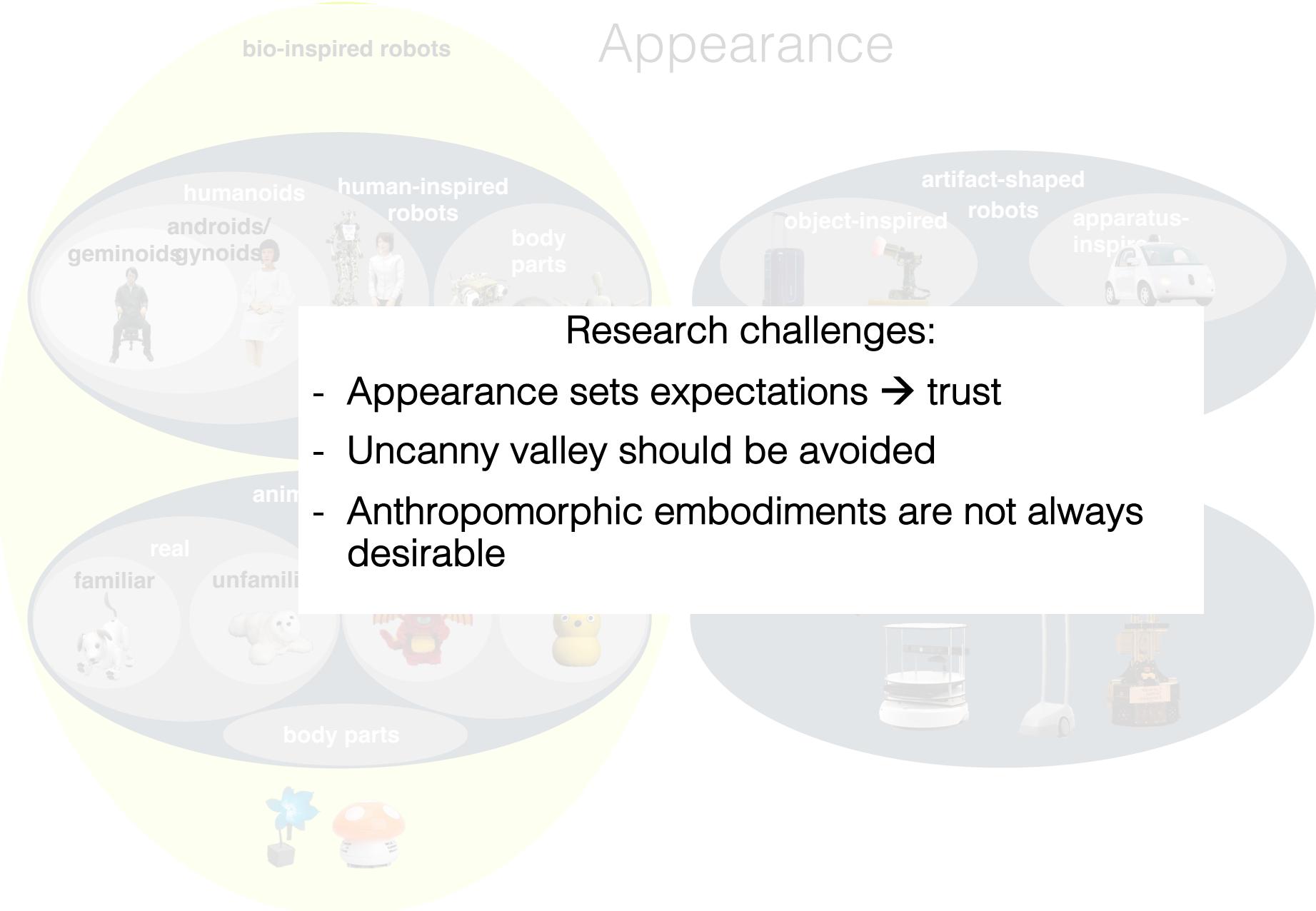
INTERACTION
**Proximity
Temporal profile**



Appearance



Appearance



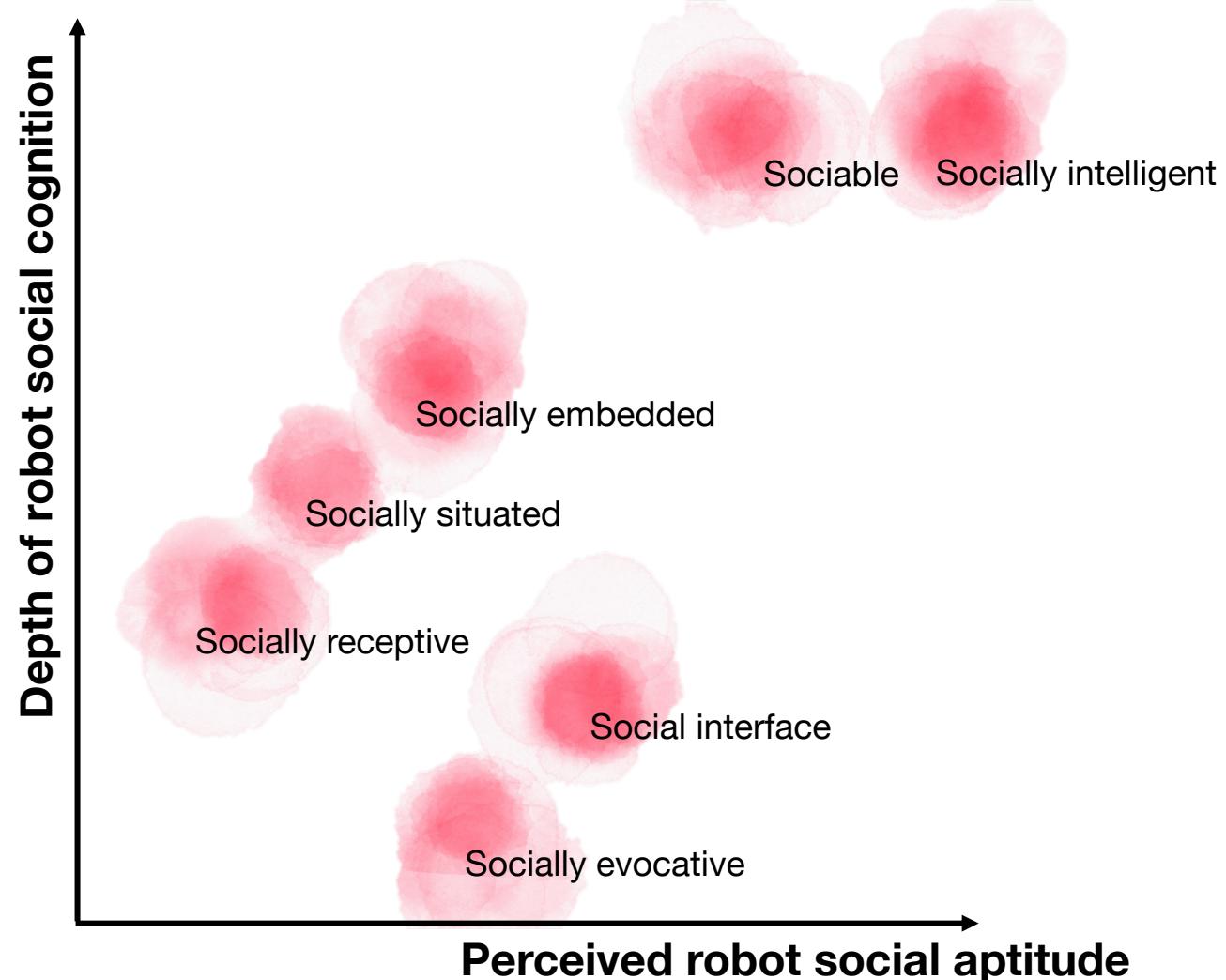
Social capabilities

Components of social interactivity for robots (adapted from Fong et al. 2002):

- Communicating using natural language or non-verbal modalities
- Expressing affect and/or perceiving human emotions
- Exhibiting distinctive personality and character traits
- Modeling and recognizing social aspects of humans
- Learning and developing new social skills and competencies
- Establishing and maintaining social relationships

Social capabilities

- **Socially evocative:** evoke social and emotional responses in humans
- **Social interface:** use human-like social cues and communication
- **Socially receptive:** socially passive but benefit from interaction
- **Socially situated:** surrounded by a social environment they can interact with
- **Socially embedded:** structurally coupled with social environment and aware of interactional structures
- **Sociable:** pro-actively engage with humans to satisfy internal social aims
- **Socially intelligent:** human-style social intelligence with deep models of cognition and social competence



Social capabilities

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Micro-assignment

Components of social interactivity for robots (adapted from Fong et al. 2002):

- Communicating using natural language or non-verbal modalities
- Expressing affect and/or perceiving human emotions
- Exhibiting distinctive personality and character traits
- **Modeling and recognizing social aspects of humans**
- Learning and developing new social skills and competencies
- Establishing and maintaining social relationships

Pick one specific problem related to “modeling and recognizing social aspects of humans” and sketch what an AI solution to this problem could look like (5 sentences).

Break

Back at 14:45

Purpose and application area

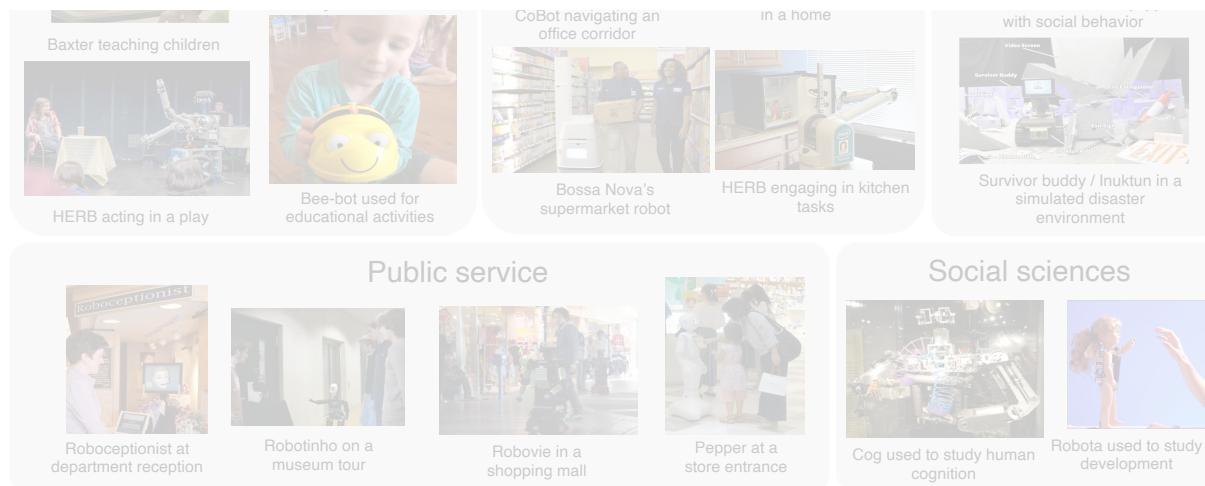


Purpose and application area

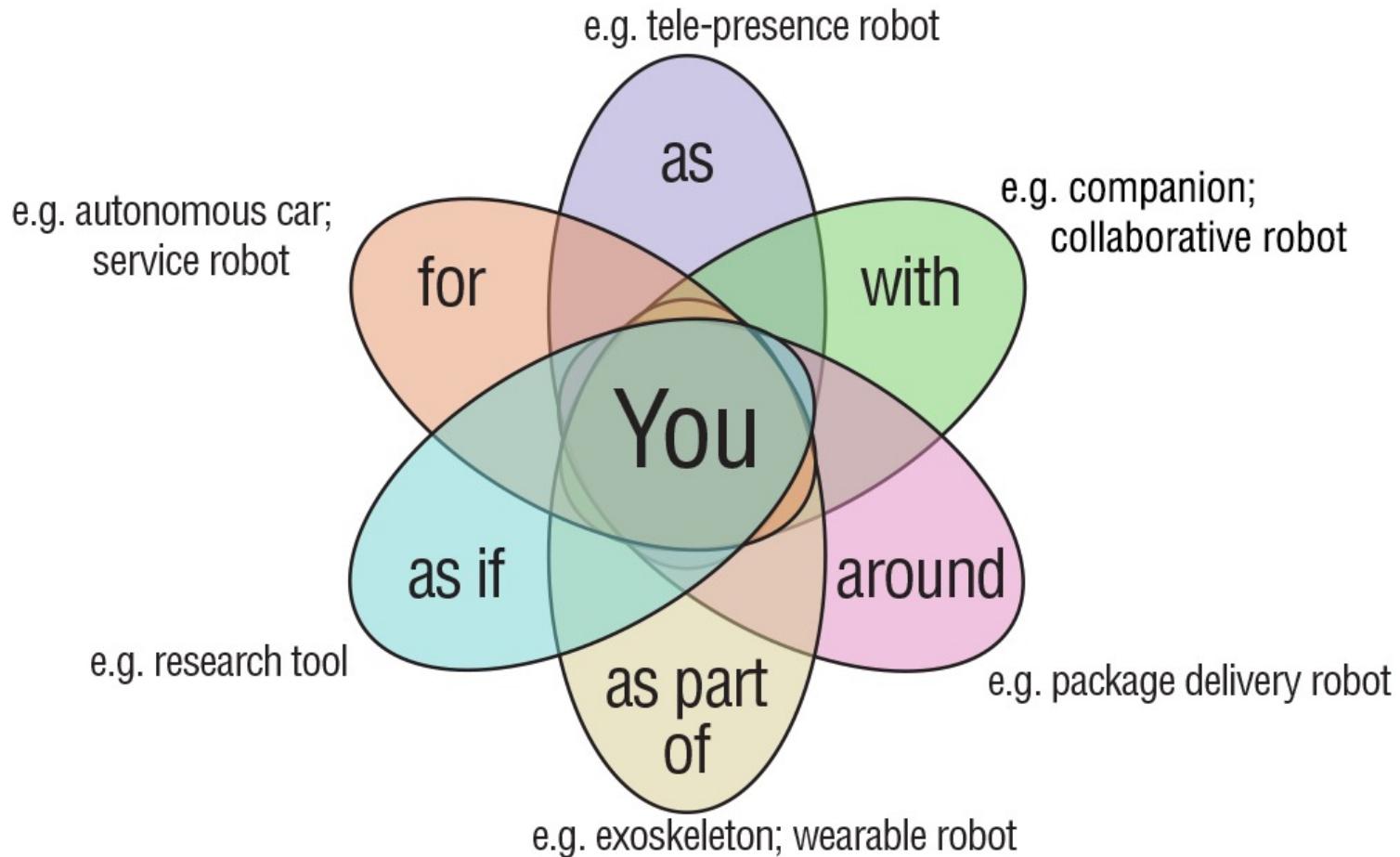


Research challenges:

- User-centered design based on intended application
- Expand to new applications areas



Relational role



Relational role

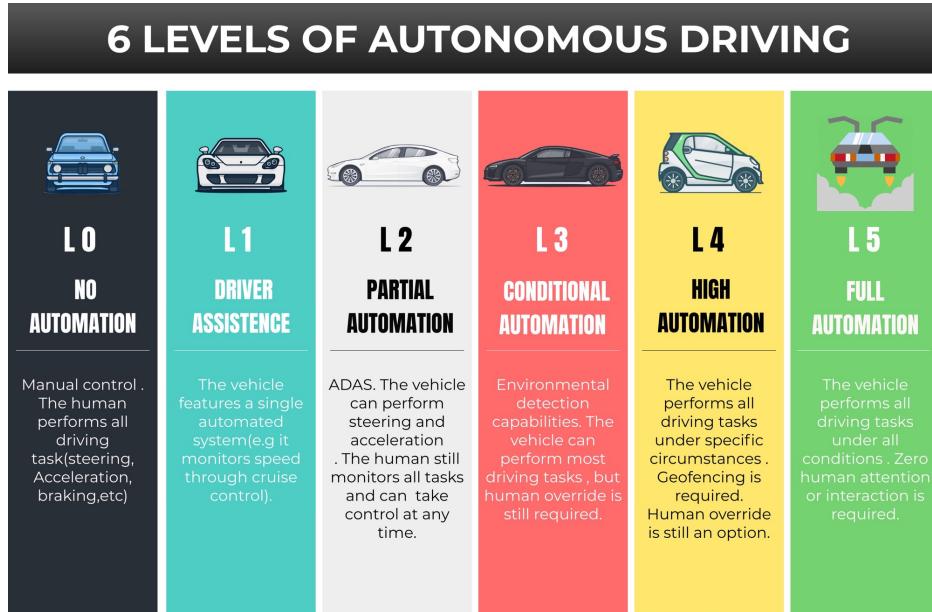


Research challenges:

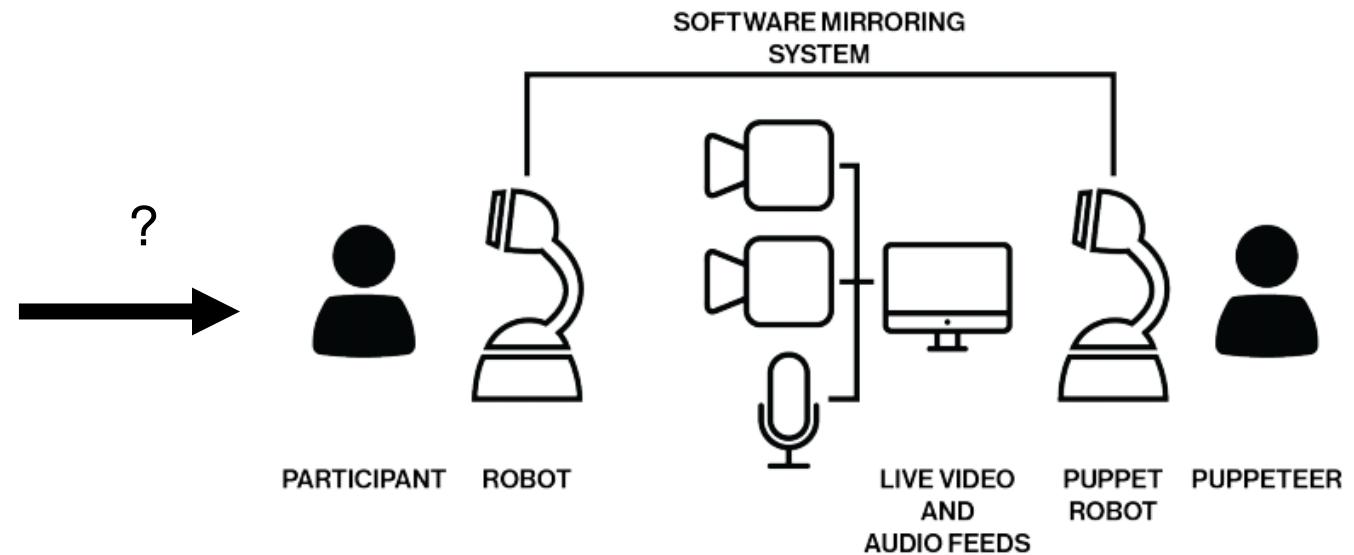
- Consider how the role of the robot affects the interaction dynamics
- Expand to new roles



Autonomy and intelligence



Source: medium.com (user Pratyush Atri)

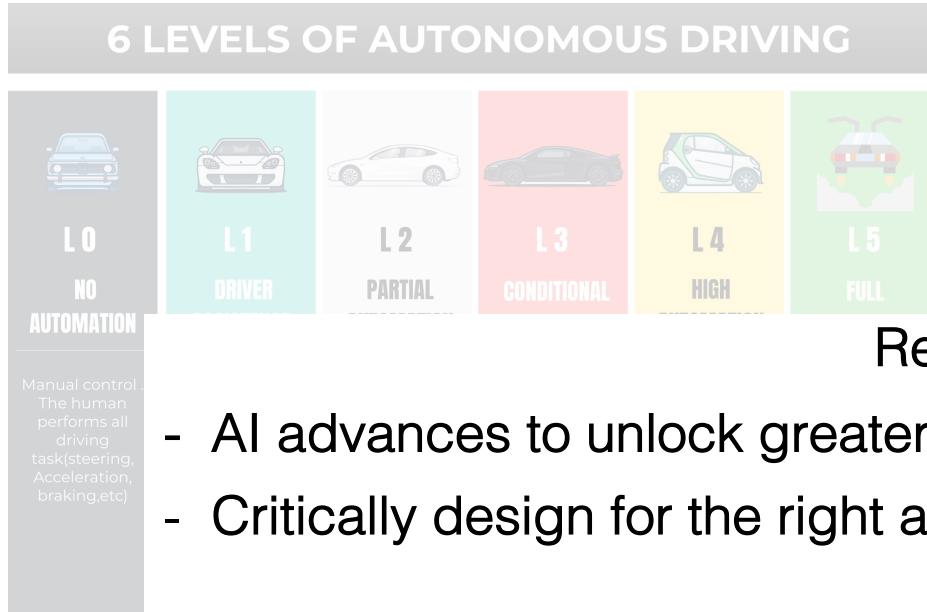


Tennent et al., HRI 2018

Autonomy — “The extent to which a robot can operate in the tasks it was designed for (or that it creates for itself) without external intervention.”

Intelligence — “The ability to determine behavior that will maximize the likelihood of goal satisfaction under dynamic and uncertain conditions, linked to the environment and the interaction with other (possibly human) agents.

Autonomy and intelligence



?

Research challenges:

- AI advances to unlock greater possibilities of autonomy
- Critically design for the right amount of autonomy according to the application

Source: medium.com (user Pratyush Atri)

Tennent et al. HRI 2018

Autonomy—“The extent to which a robot can operate in the tasks it was designed for (or that it creates for itself) without external intervention.”

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Proximity

Remote



Photo credit: iRobot

- Latency
- Social presence
- Shared autonomy
- Non-verbal communication
(e.g., gaze and proxemics)
- ...

Co-located



Physical



- Haptic control
- Social meaning of touch
- Safety

Temporal profile

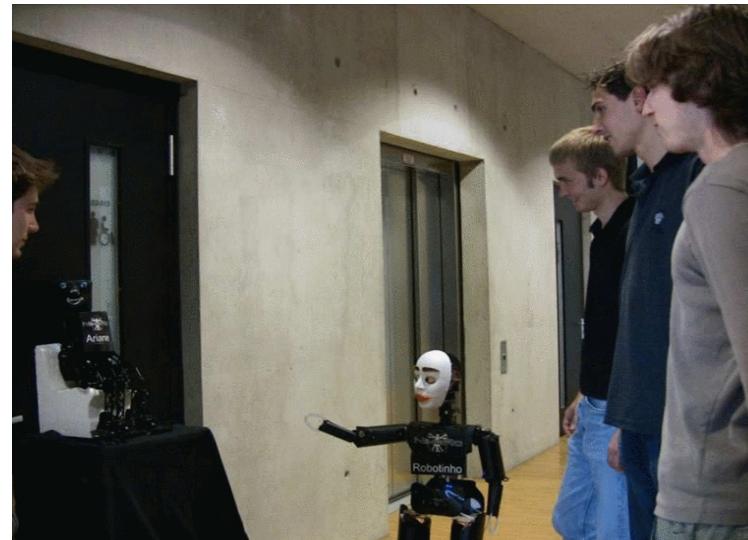
Timespan

Short-term



Zeglin et al., 2014

Medium-term



Faber et al., 2009

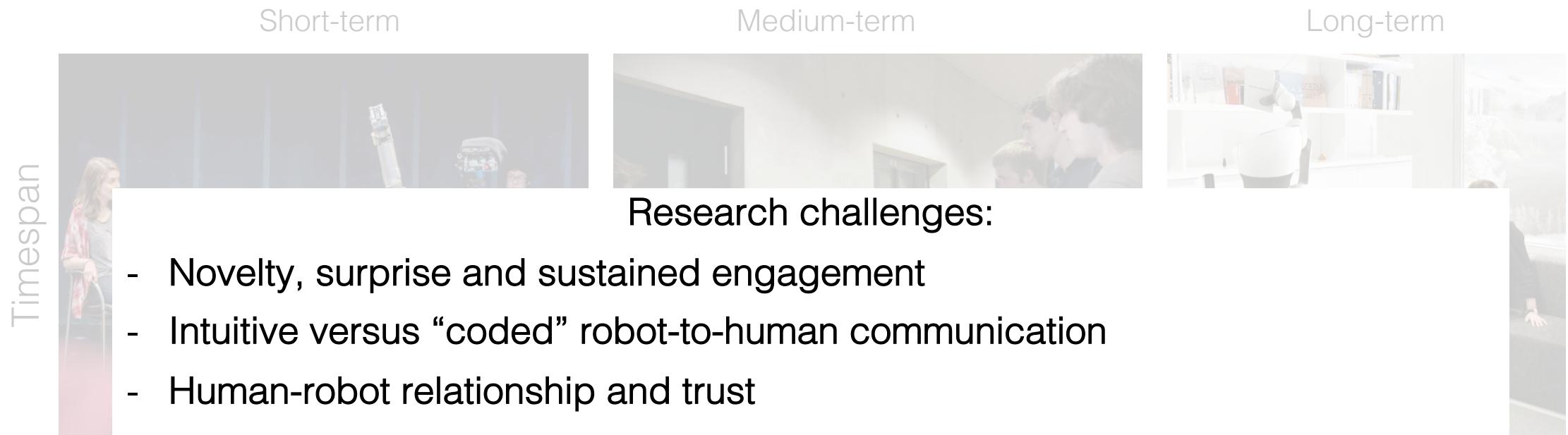
Long-term



Baraka et al., 2016

Also consider duration and frequency of interactions

Temporal profile



Also consider duration and frequency of interactions

CONTEXT

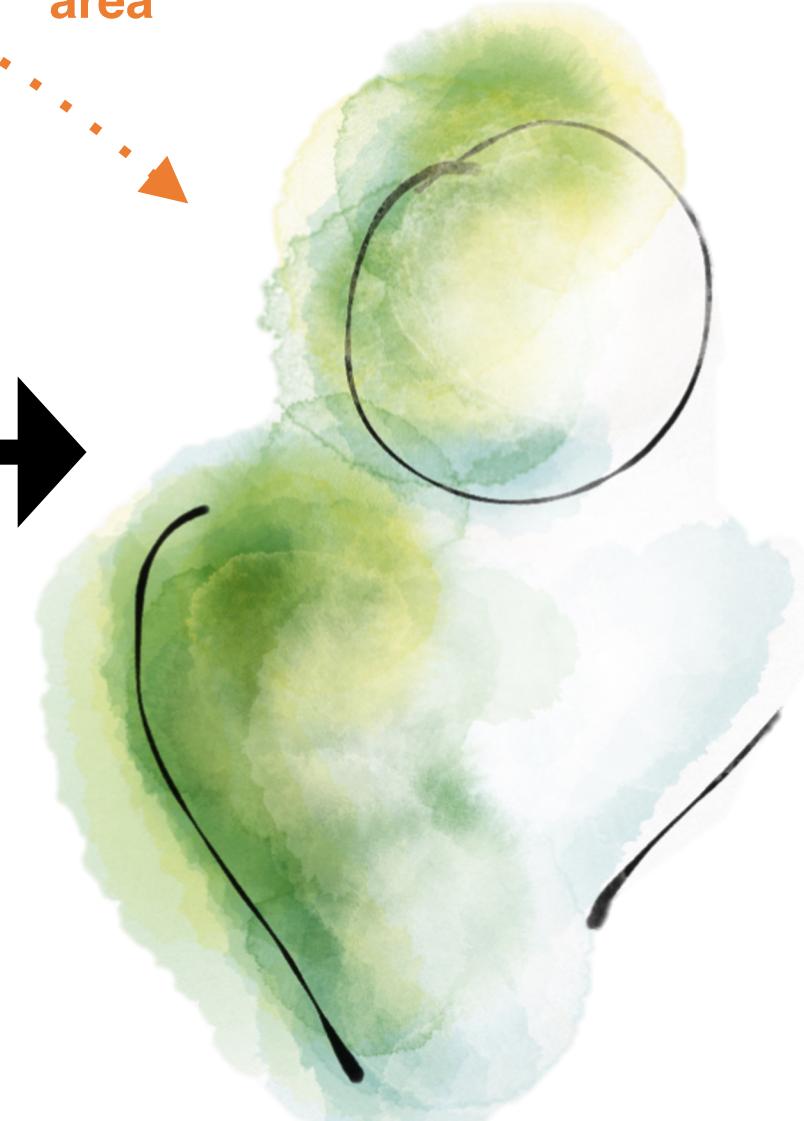


**Appearance
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Relational role

Purpose and application area

INTERACTION
**Proximity
Temporal profile**



What other dimensions would you add to this framework?

Additional resources for HRI

- “Human-Robot Interaction – An Introduction” (Bartneck et al., 2020)
- “Computational Human-Robot Interaction” (Thomaz et al., 2013)
- “A Primer for Conducting Experiments in Human-Robot Interaction” (Hoffman et al., 2020)
- Séverin Lemaignan’s slides on computational HRI
- For research articles: ACM/IEEE HRI conference proceedings and HRI Transactions Journal (<https://humanrobotinteraction.org/>)

