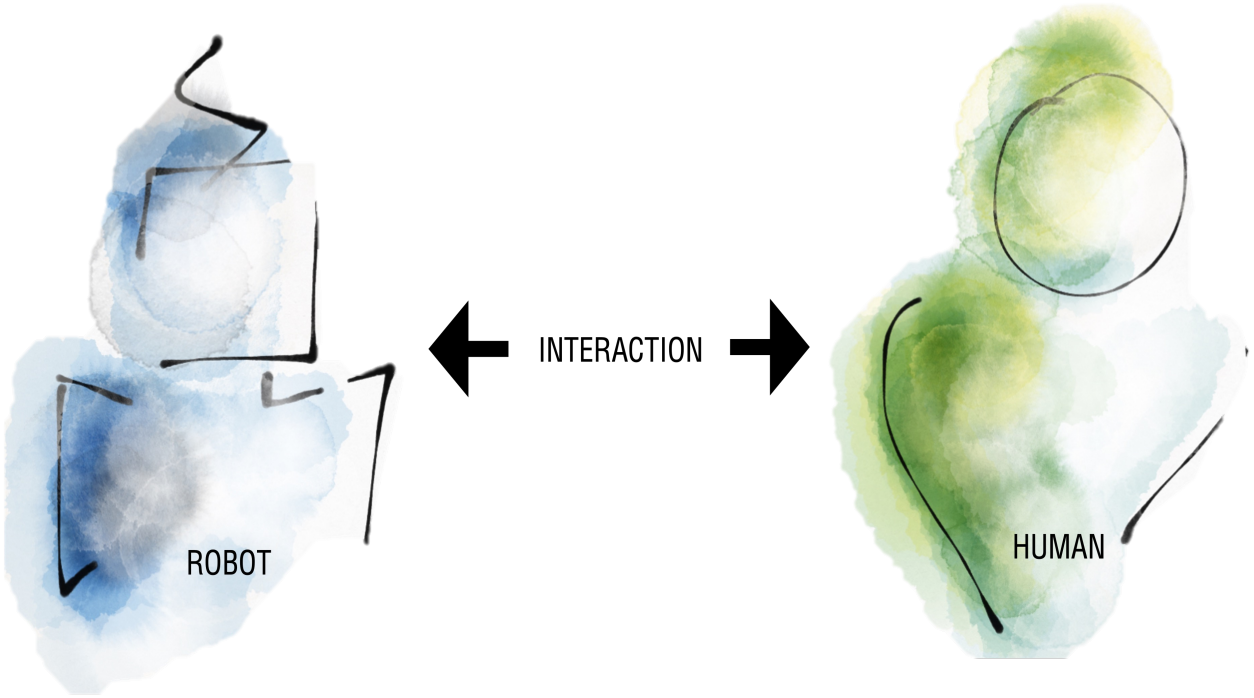


Lecture 2
“I am social robot.”
Dimensions of social robot design

Kim Baraka
Assistant Professor
Social AI group

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

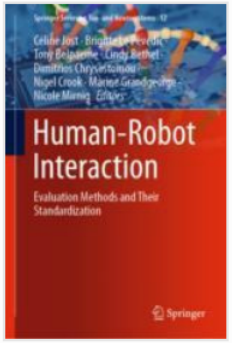
Defining “social robots”

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

A**ppearance** and **behavio**r 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

Purpose and application area

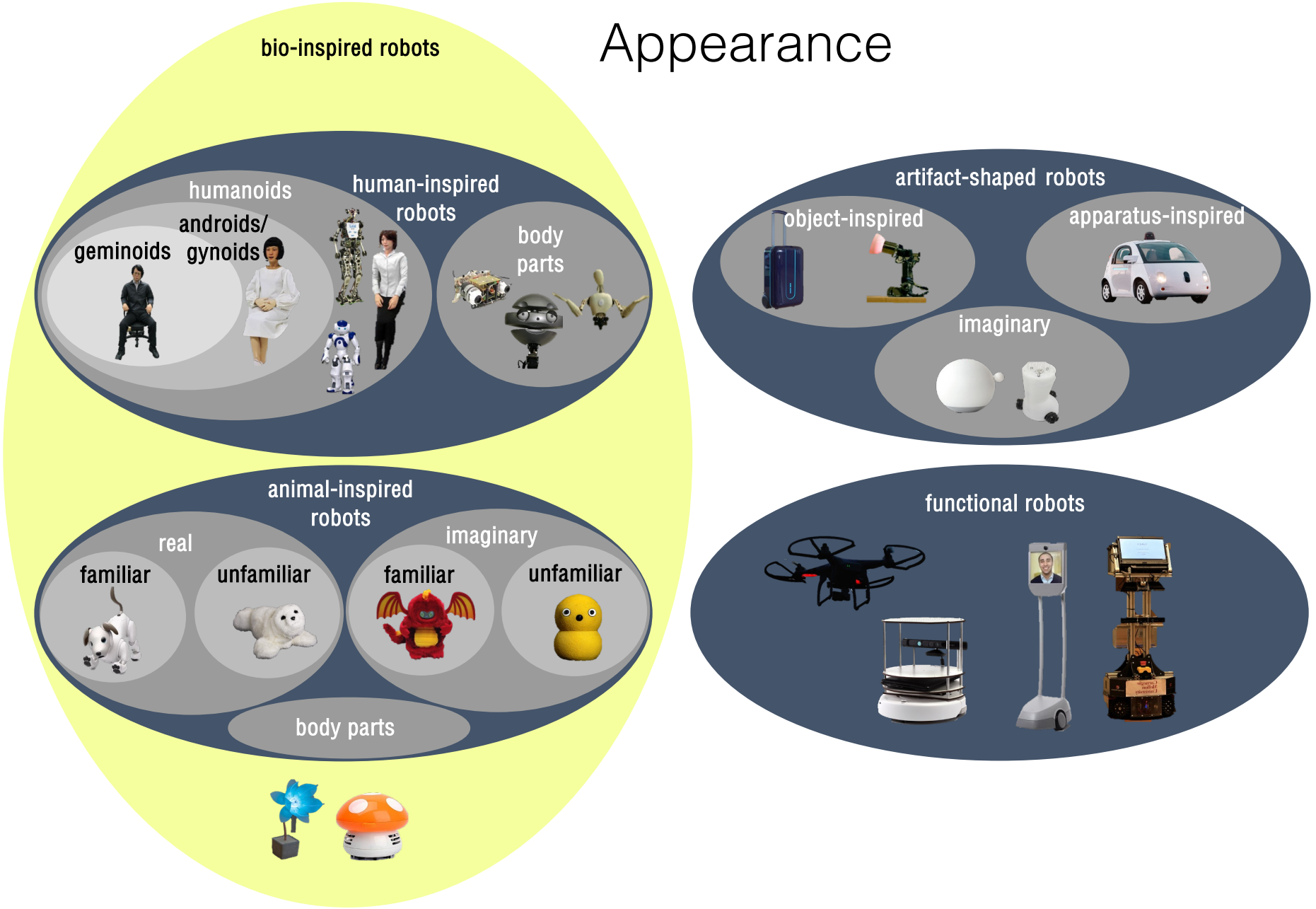
Relational role

INTERACTION

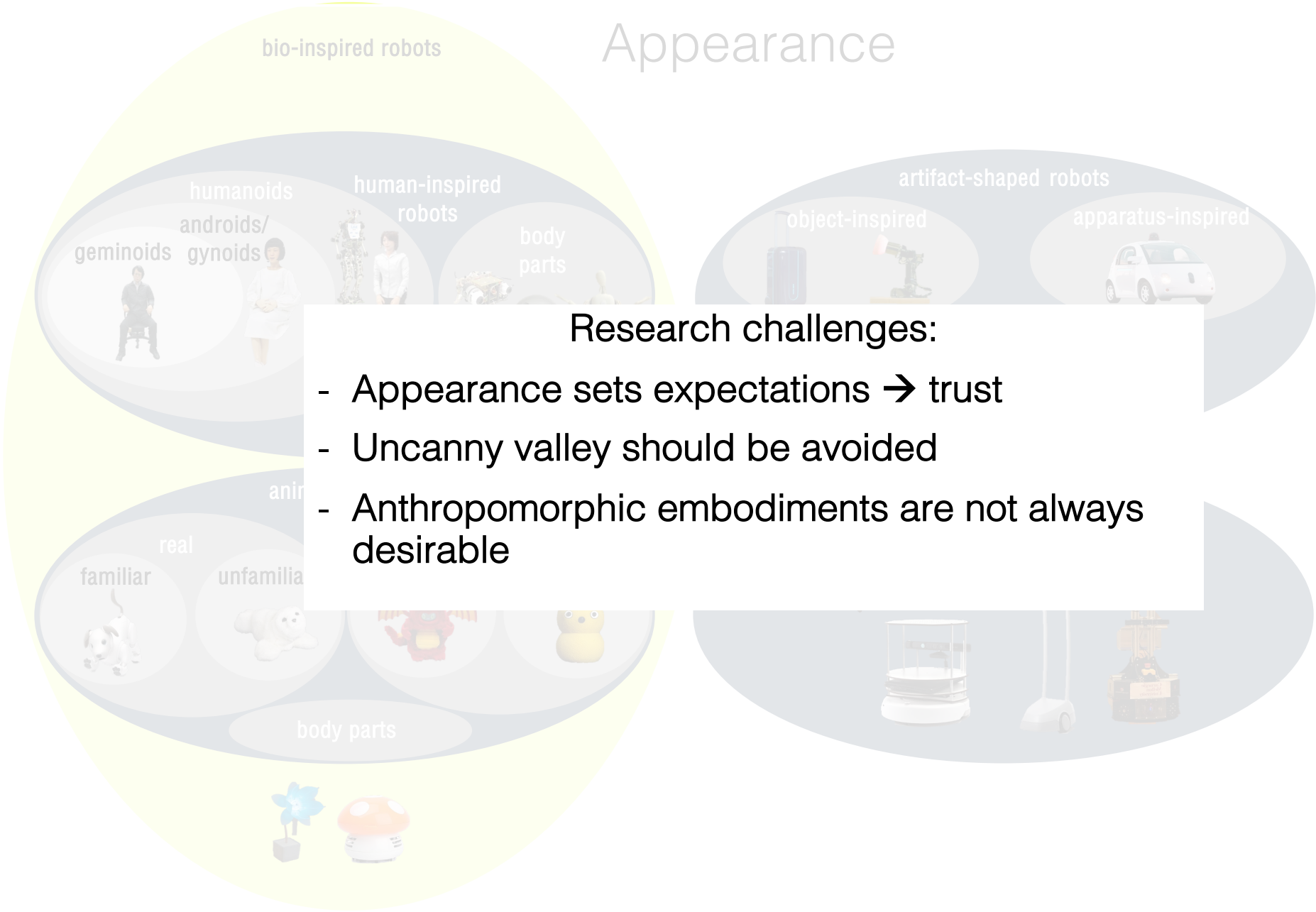
Proximity
Temporal profile

Appearance
Social capabilities
Autonomy and intelligence

Appearance


bio-inspired robots
humanoids
androids/
gynoids
geminoids
human-inspired
robots
body
parts
animal-inspired
robots
real
familiar
unfamiliar
imaginary
familiar
unfamiliar
body parts
artifact-shaped robots
object-inspired
apparatus-inspired
imaginary
functional robots

Appearance



Research challenges:

- Appearance sets expectations → trust
- Uncanny valley should be avoided
- Anthropomorphic embodiments are not always desirable

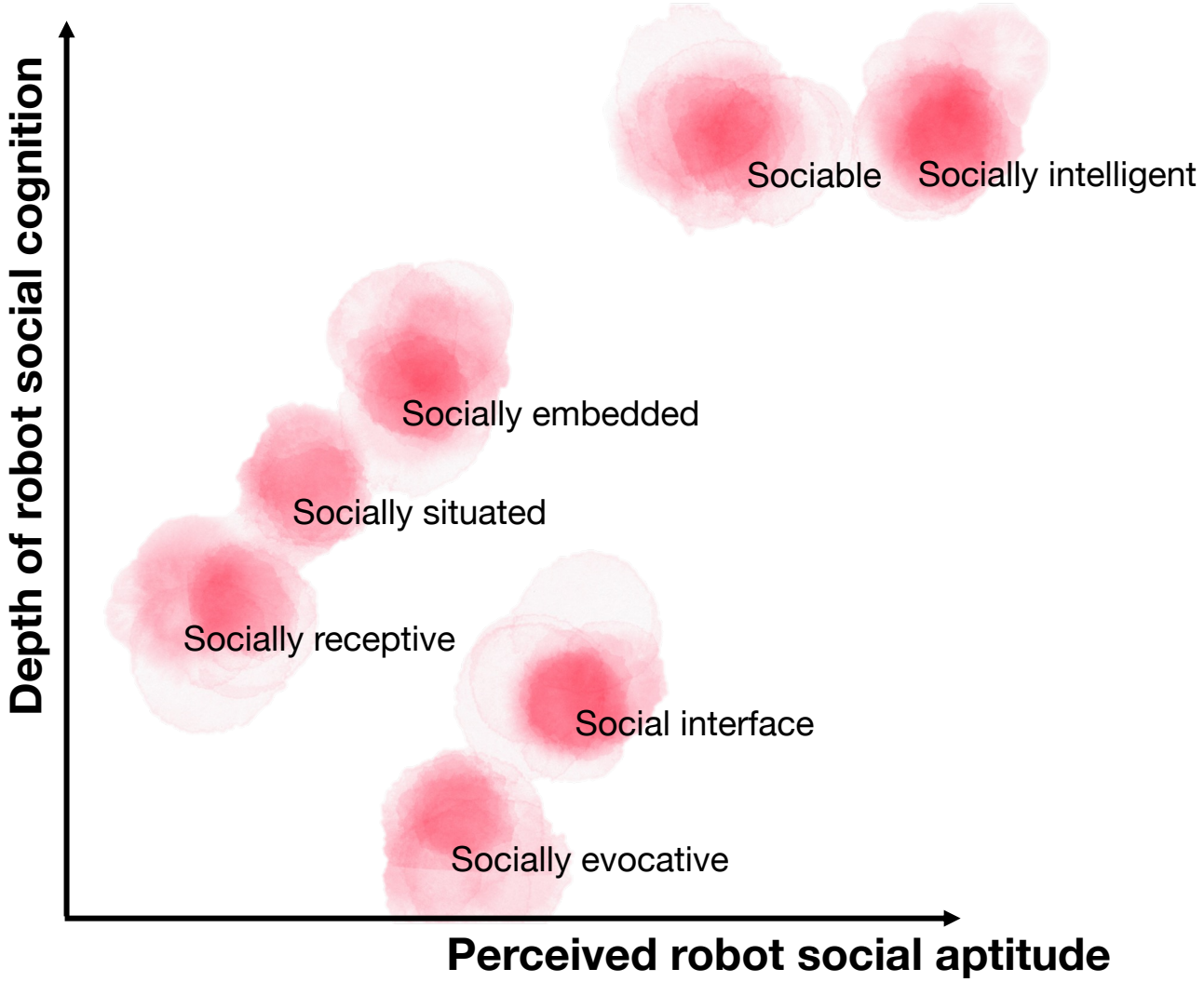
Social capabilities

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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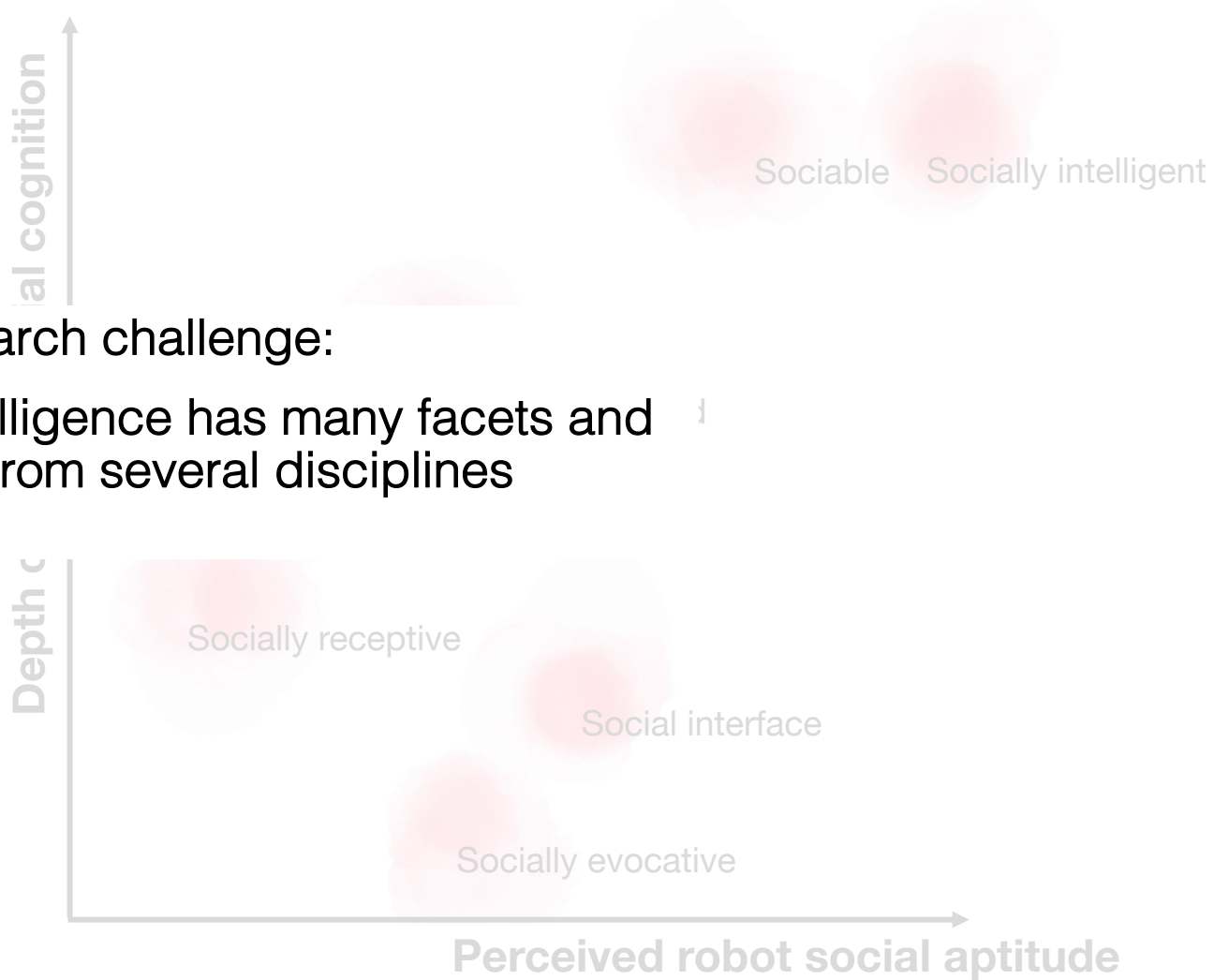


Research challenge:

Designing social intelligence has many facets and requires knowledge from several disciplines

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

Healthcare and therapy


NAO and child with ASD interacting


Paro emotionally assisting the elderly


Baxter assisting a blind person


Robota assisting a child with ASD


Pearl assisting an elder person


SeRoDi assisting an elder person


Robear carrying a patient

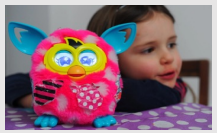
Industry


Baxter being synesthetically taught in a factory


Locusbots™ collaboratively operating in a warehouse

Education, entertainment and art


Baxter teaching children


Furby with a child

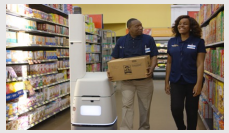

HERB acting in a play


Bee-bot used for educational activities

Home and workplace


CoBot navigating an office corridor

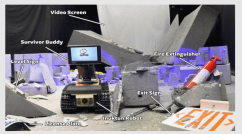

Care-O-bot 4 in a home


Bossa Nova's supermarket robot


HERB engaging in kitchen tasks

Search and rescue


Inuktun and Packbot equipped with social behavior


Survivor buddy / Inuktun in a simulated disaster environment

Public service

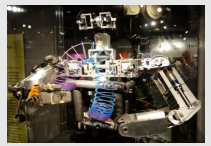
Roboceptionist at department reception


Robotinho on a museum tour


Robovie in a shopping mall


Pepper at a store entrance

Social sciences


Cog used to study human cognition

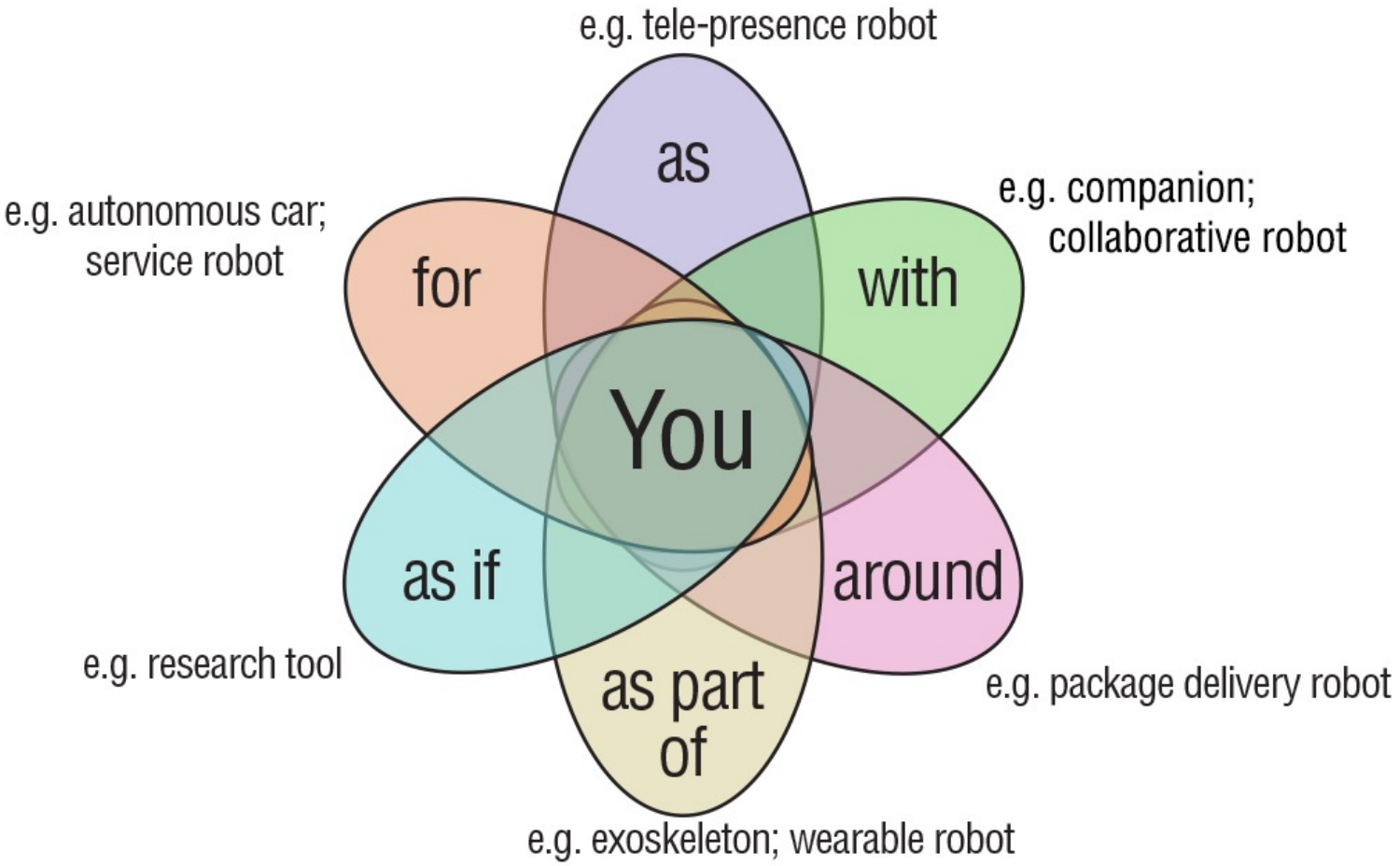

Robota used to study development

Purpose and application area

Research challenges:

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

Relational role

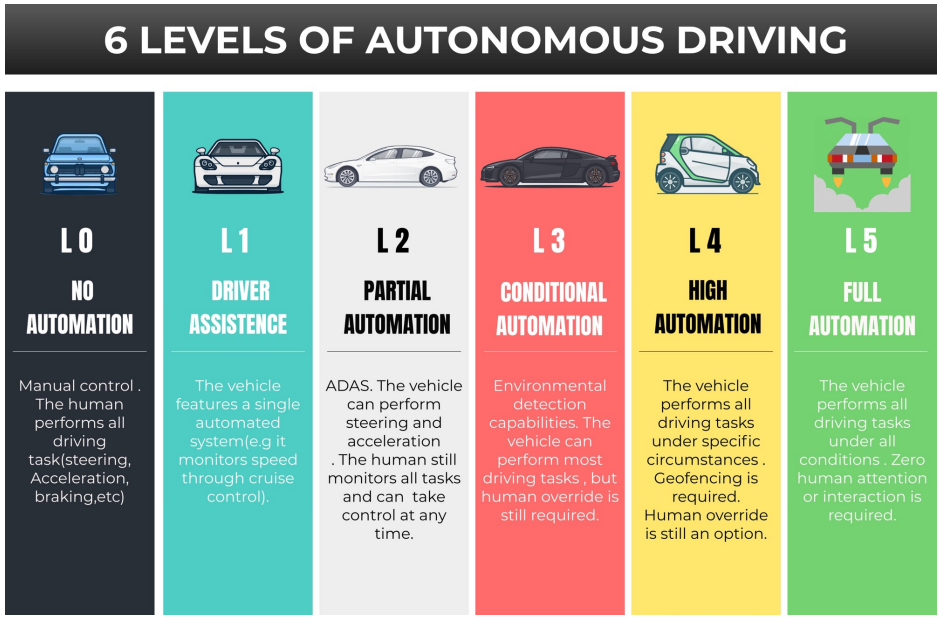


Relational role

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)

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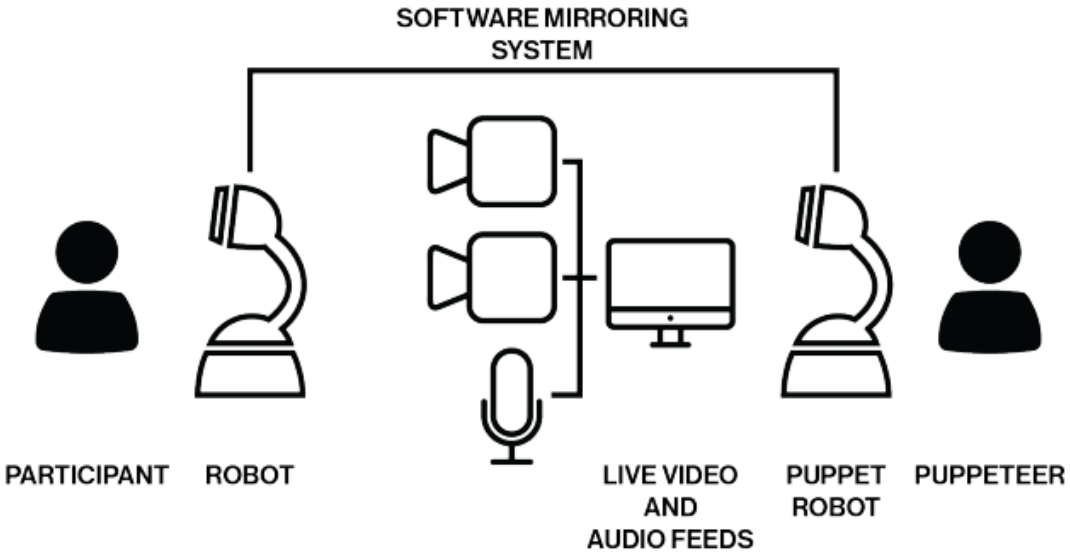
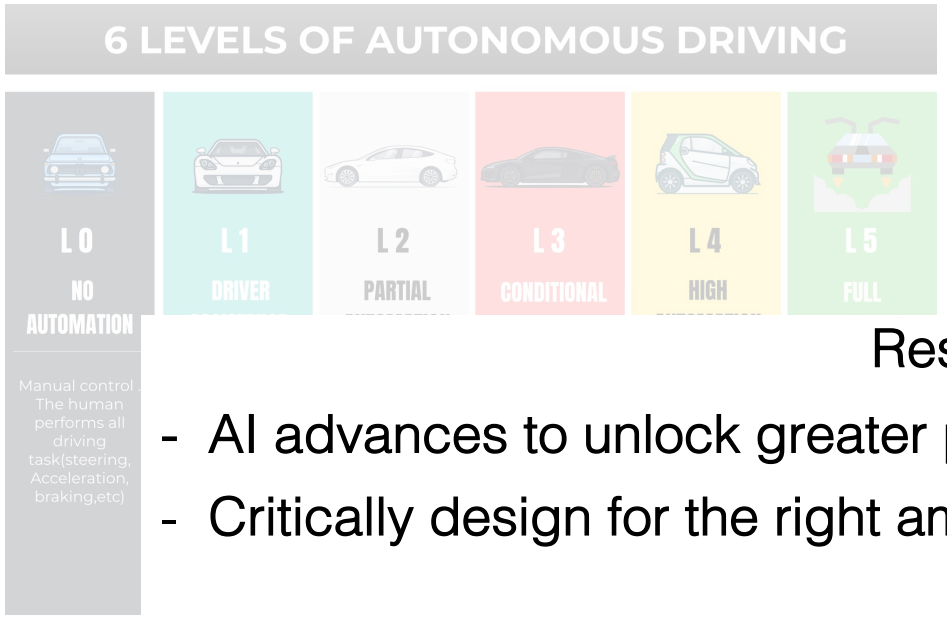


Tennent et al., HRI 2018

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



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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."

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.

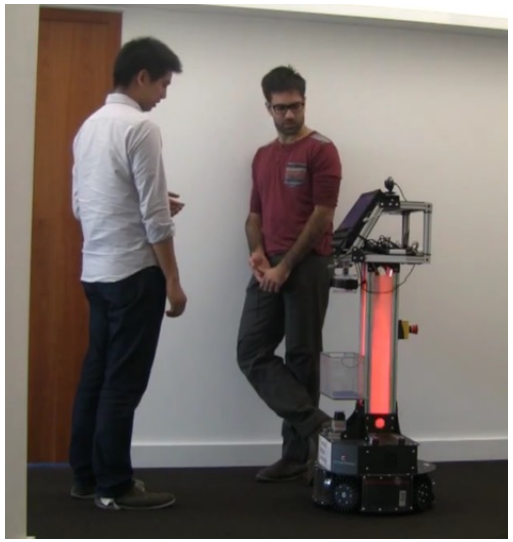
Proximity

Remote

Photo credit: iRobot

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

Co-located



- Situated communication
- Social navigation
- Perception of social cues
- …

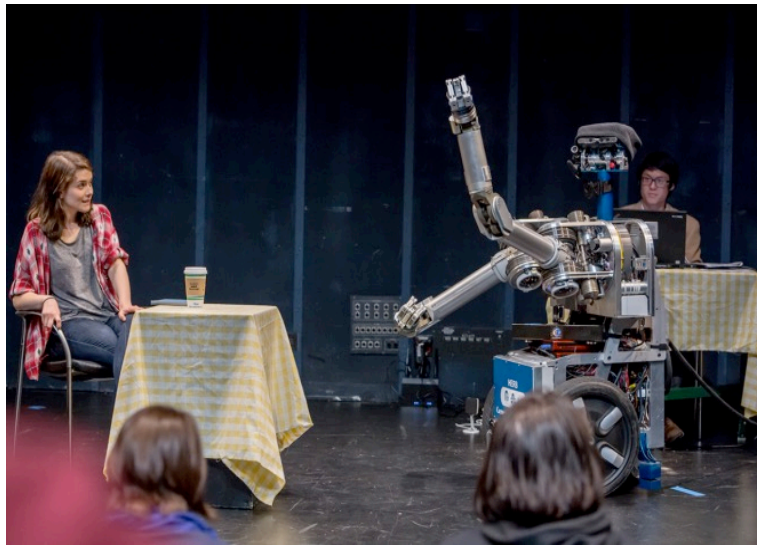
Physical

- Haptic control
- Social meaning of touch
- Safety

Temporal profile

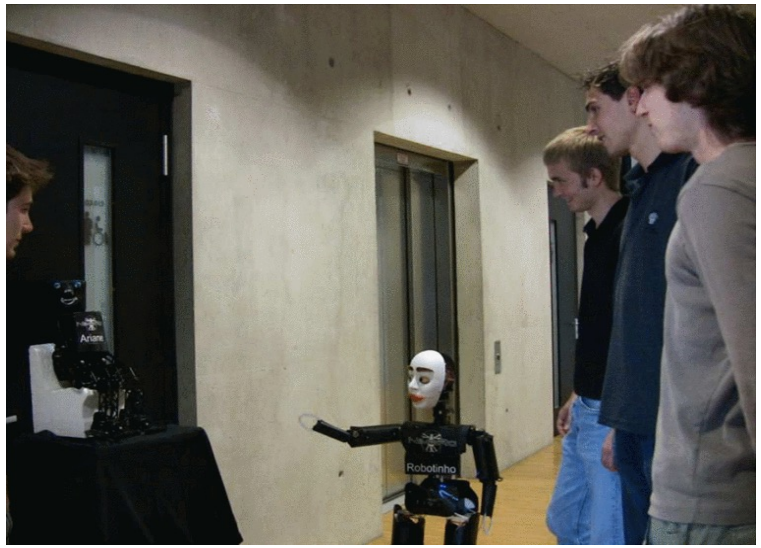
Timespan

Short-term



Zeglin et al., 2014

Medium-term



Faber et al., 2009

Long-term

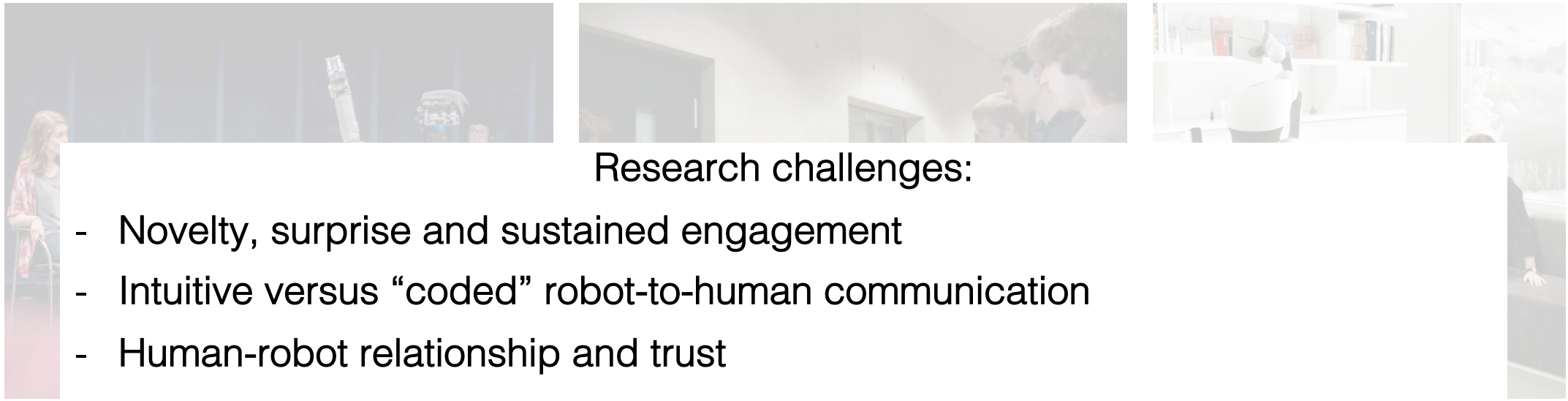
Baraka et al., 2016

Also consider **duration** and **frequency** of interactions

Temporal profile

Short-term | Medium-term | Long-term

Timespan



Research challenges:

- Novelty, surprise and sustained engagement
- Intuitive versus “coded” robot-to-human communication
- Human-robot relationship and trust

Also consider **duration** and **frequency** of interactions

CONTEXT

Appearance
Social capabilities
Autonomy and intelligence

Relational role

INTERACTION

Proximity
Temporal profile

Purpose and application area

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/)