

FND: Human-Robot Collaboration with Distributed and Embodied Intelligence



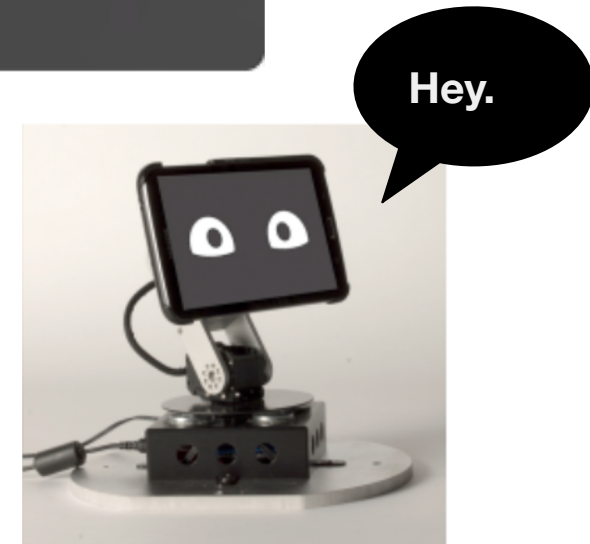
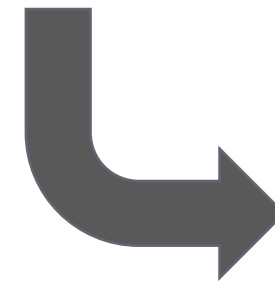
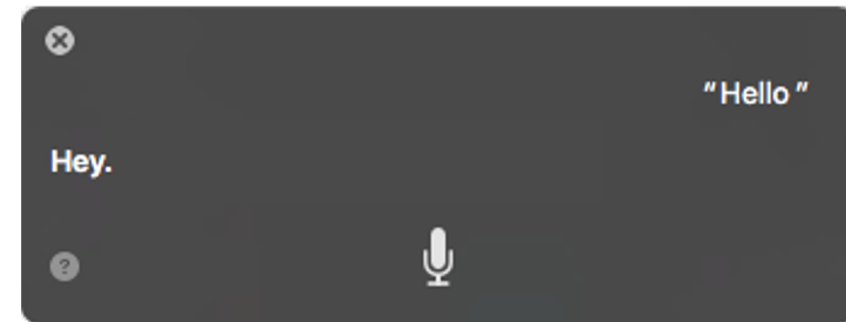
SES 1734456 • 2017 • John Zimmerman & Aaron Steinfeld, Carnegie Mellon University

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Collaborator: Jodi Forlizzi, Human-Computer Interaction Institute

Key Problem

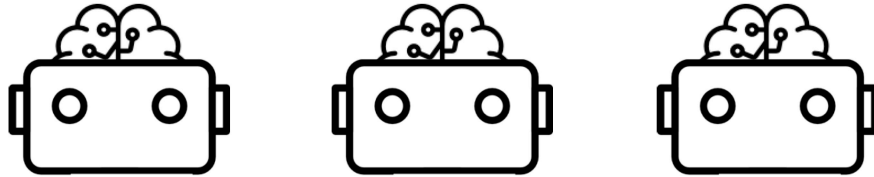
- Embodied intelligences and agents are becoming ubiquitous
- They will migrate across multiple physical platforms to meet different needs for their users in different contexts
- What embodiment interactions are acceptable?
- What are the important factors?



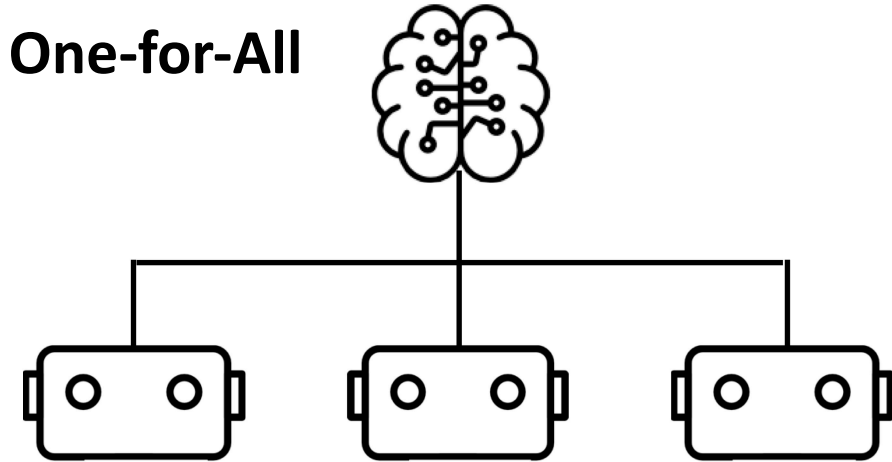
Types of Embodiment



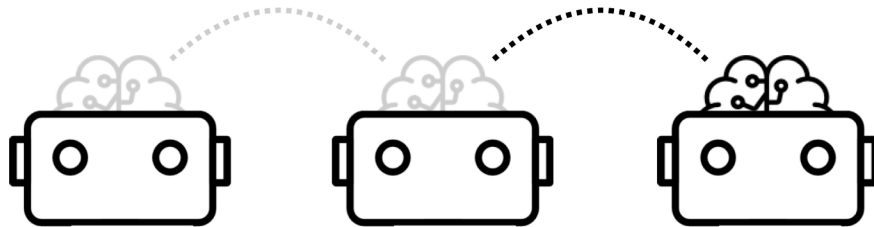
One-for-One



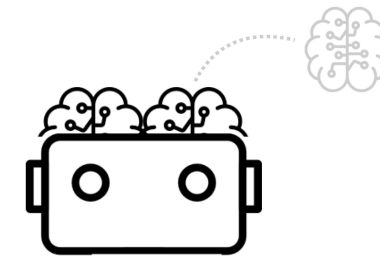
One-for-All



Re-embodiment



Co-embodiment



Luria et al



- How should agents present their social presence?
- User enactments methodology (similar to speed dating)



DMV



Home and Work



Health Center



Autonomous Car

Guidelines



1. Should agents always act human-like? **No.**
2. Should agents have expertise? **Sometimes.**
3. Should agents express their “cognitive” ability? **Yes.**
4. Should agents interact with each other? **Probably, but we don’t know how.**

Guidelines



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P12: “Autonomous driving intelligences should only be related to autonomous driving!”

P07: “I don’t know the requirement of the capacity... focus on the safety instead of the talking.”

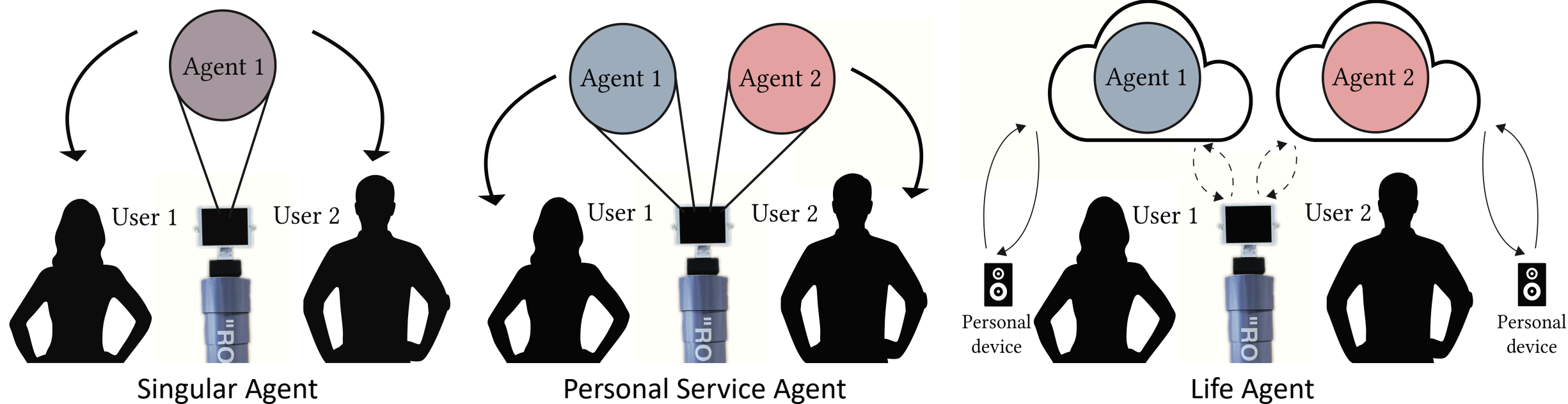
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Multi-Person Interaction and Service Robots



(RQ1) How should a robot personalize its performance of service with multiple users?

(RQ4) How, if ever, should re-embodiment agents cross contextual boundaries?



Findings

- Life Agent > Singular Agent > Personal Service
- People prioritized social competence and personalization during group interactions
- People want future service agents to learn their history and preferences
- Context-crossing is not always a social taboo – it may be appropriate and desired



Insights Across Studies



1. OK with re-embodiment when there is a benefit (e.g., reintroductions)
2. People view robots as having a single locus of attention, similar to a person
3. Way more comfortable with a service robot recognizing them, as compared to IoT systems
4. In most spaces, robots need knowledge of people's relevant social roles and relevant affiliations
5. Social status, expertise, and work/home all seem to be important barriers that should prevent re-embodiment

Broader Impacts



Research

- 6 peer-review papers published, with more underway
- NASA Fellowship (Reig)
- Small award from Google

Capacity & Careers

- 2 PhD students (both women)
- 4 undergrads (2 women), so far
- US leadership for HRI Pioneers 2020 (Reig & Steinfeld)

Education

- Courses, seminars, and other talks
- Independent study aligned with project mission by 3 master students

Industry

- Guidelines for new robots & agents
- Accenture, Honda, Samsung, Zazzle, InterDigital, Gilson Snowboards, Philips, Toyota, LG, Honda, Google, Amazon, and others