

The Dark Side of Embodiment

Teaming Up With Robots VS Disembodied Agents



Filipa Correia



Samuel Gomes



Samuel Mascarenhas



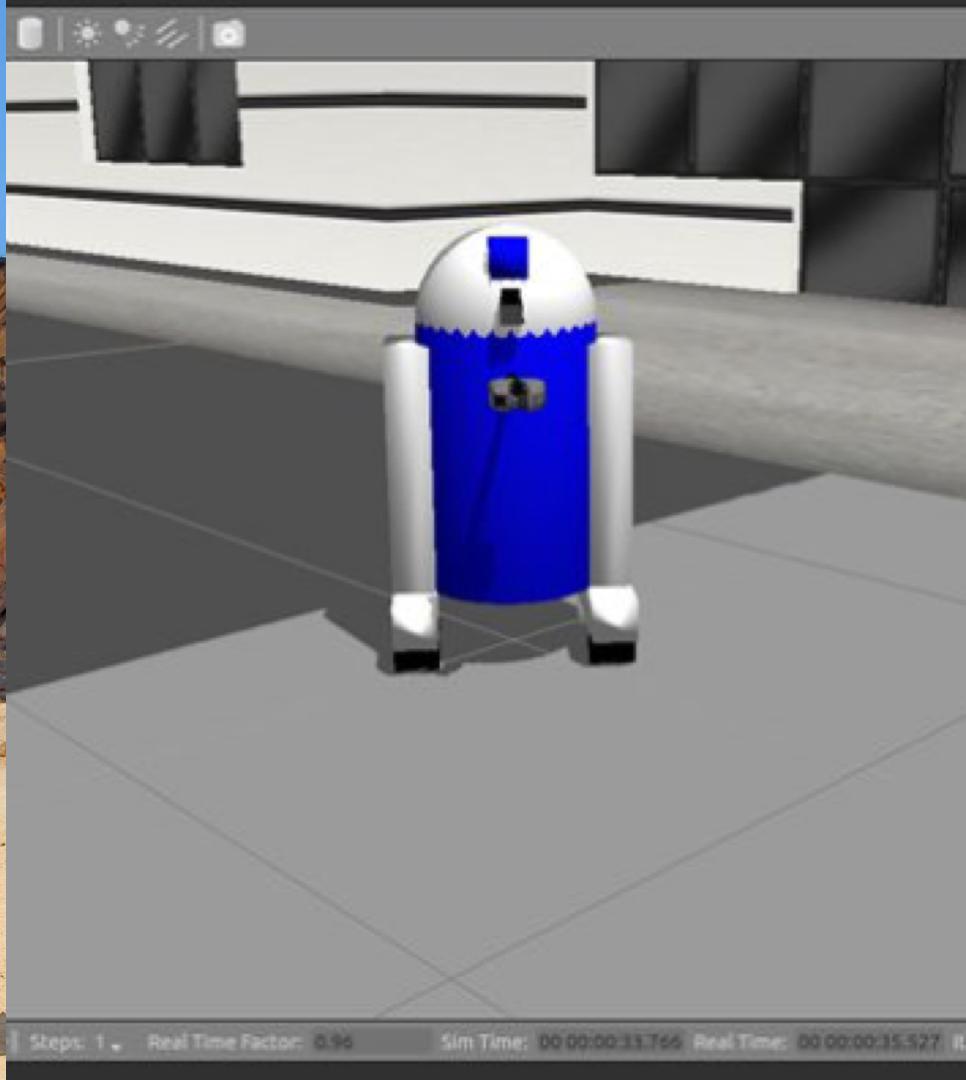
Francisco S. Melo

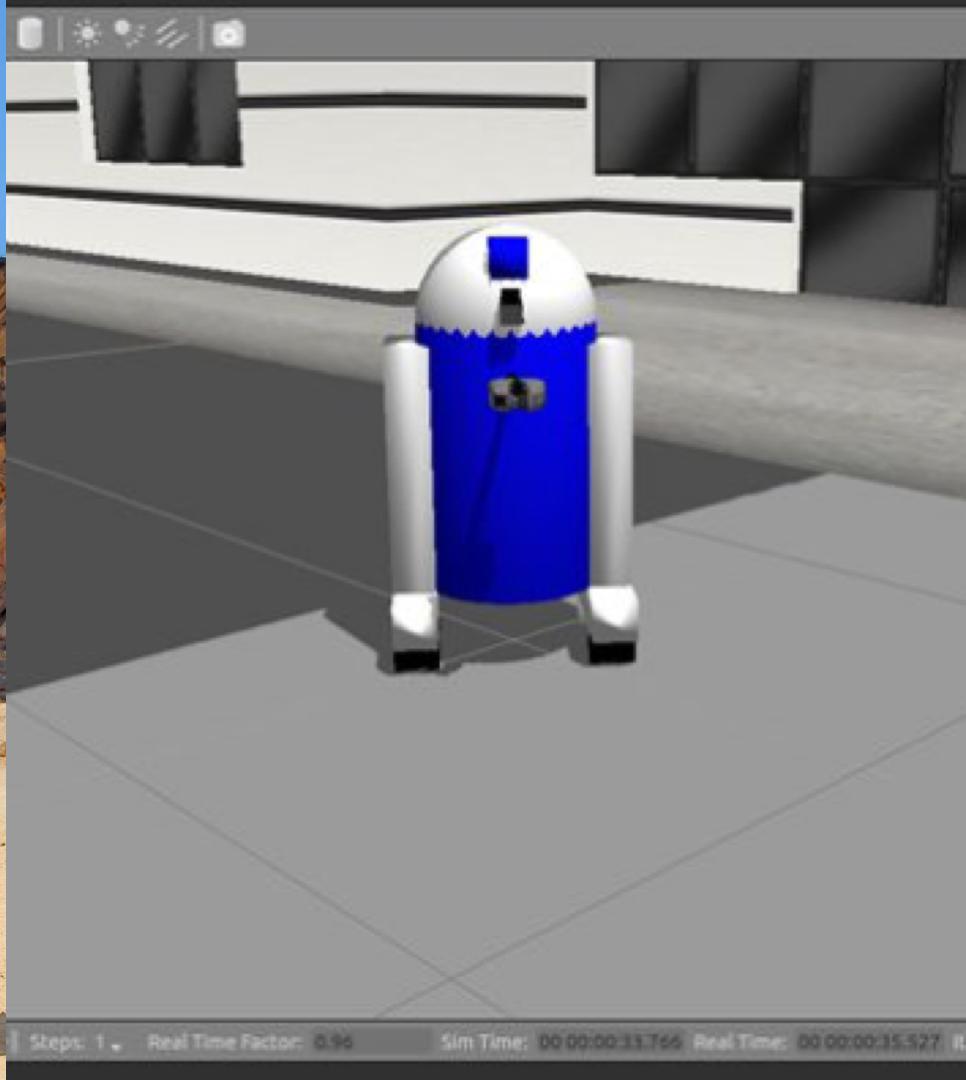


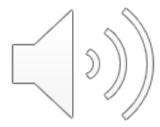
Ana Paiva

INESC-ID & University of Lisbon

Robotics: Science and Systems 2020





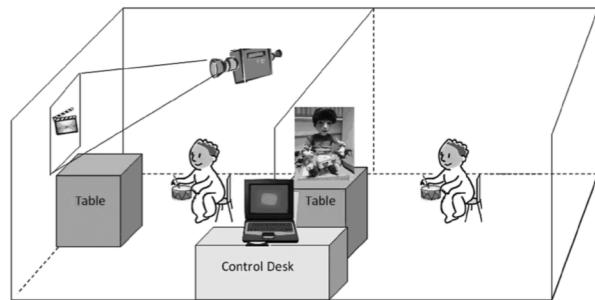




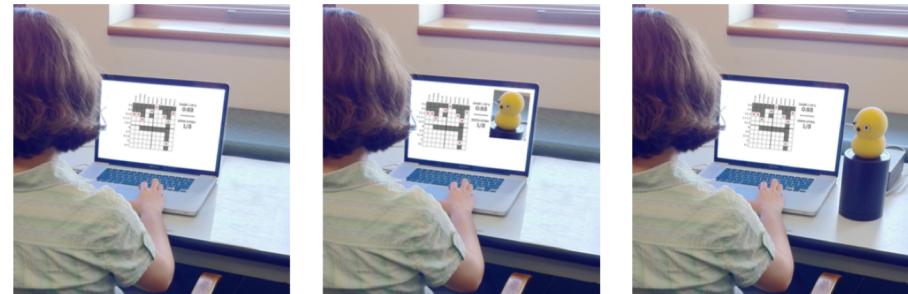
Wainer et al. 2007



Pereira et al. 2008



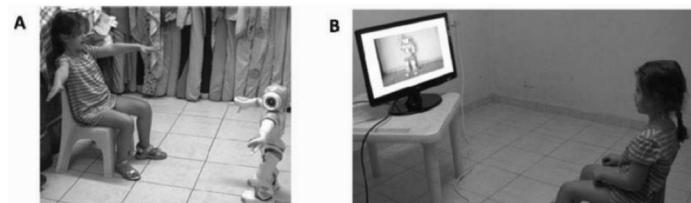
Kose-Bagci et al. 2009



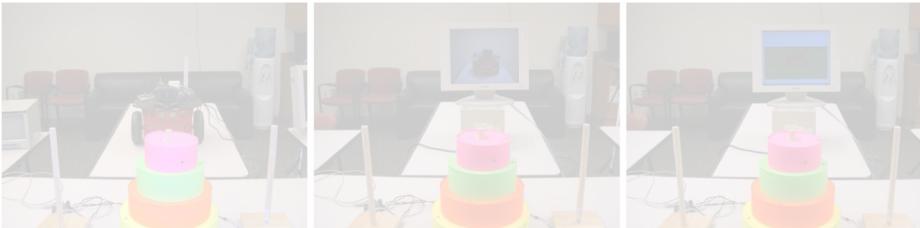
Leyzberg et al. 2012



Fasola & Matarić 2013



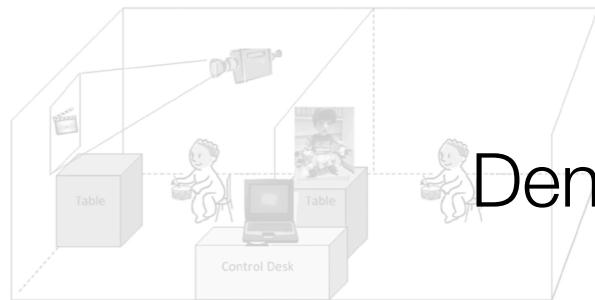
Fridin & Belokopytov 2014



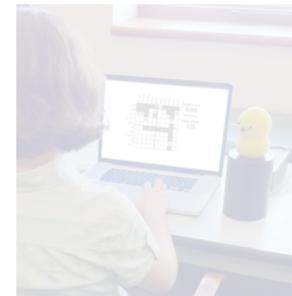
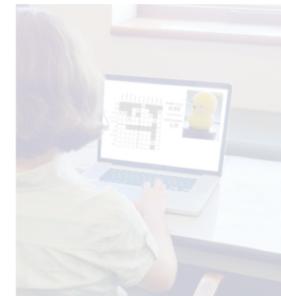
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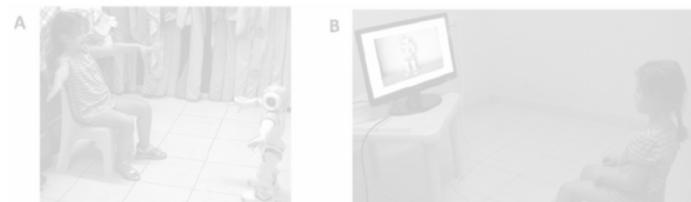
Deng et al. 2020



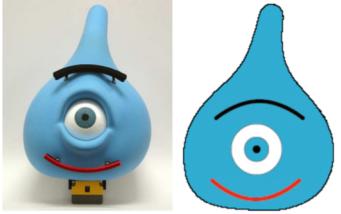
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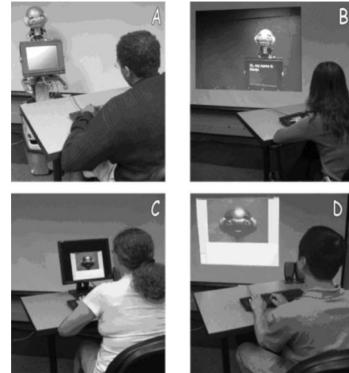
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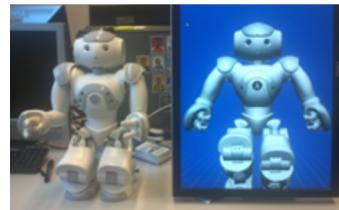
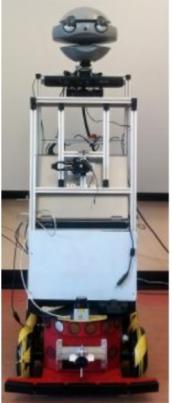
Bartneck 2003



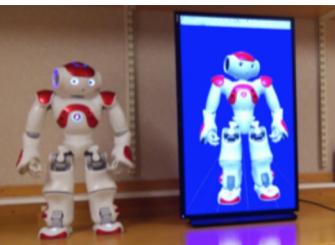
Kidd & Breazeal 2004



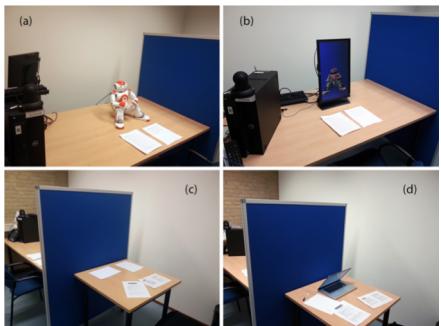
Kiesler et al. 2008



Segura et al. 2012



Looije et al. 2012



Lighthart & Truong 2015

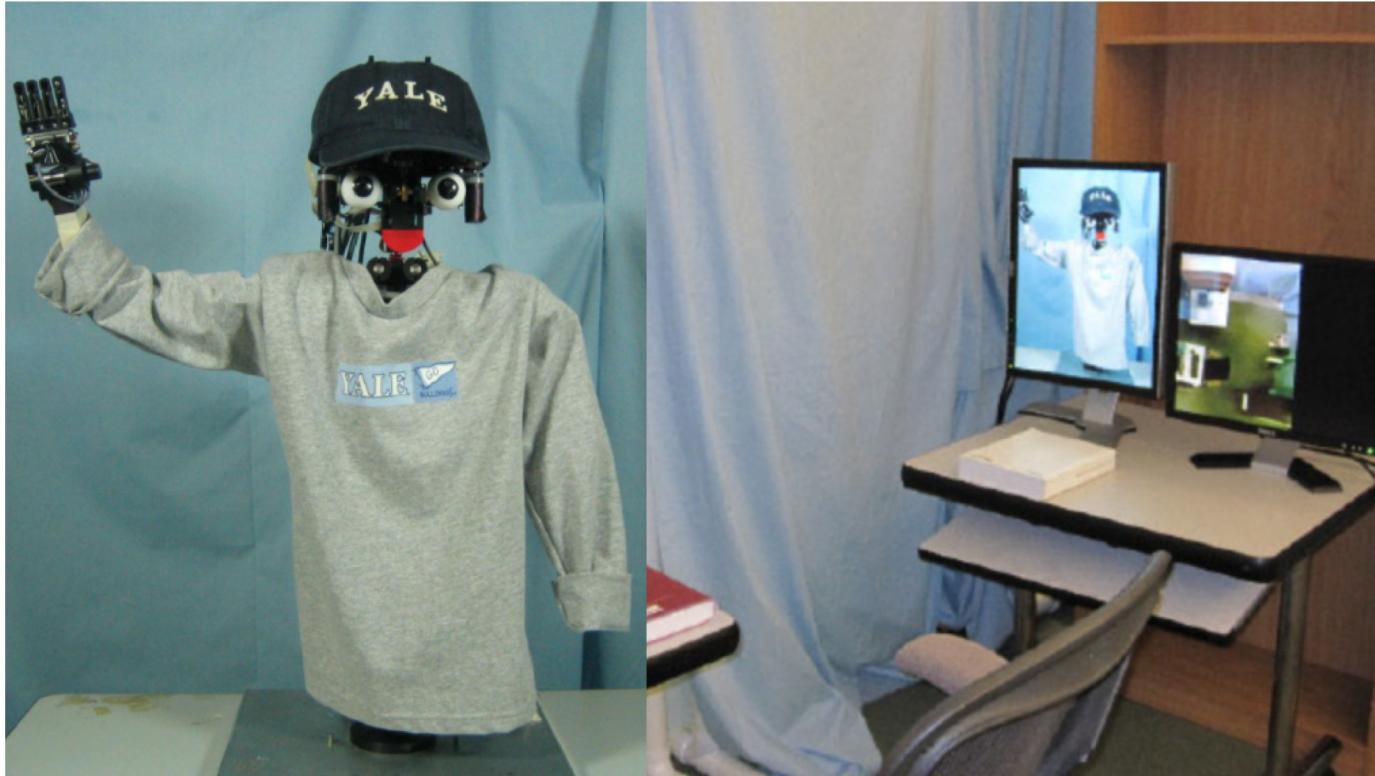


Kontogiorgos et al. 2019

Thellman et al. 2015



Hoffmann & Krämer 2013



Bainbridge et al. 2010



Kim et al. 2017

“(...) what, if anything,
is special about
material embodiment?”

Dautenhahn, K., Ogden, B., & Quick, T. (2002). From embodied to socially embedded agents—implications for interaction-aware robots. *Cognitive Systems Research*, 3(3), 397-428.



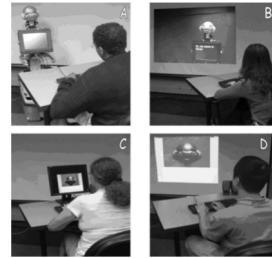
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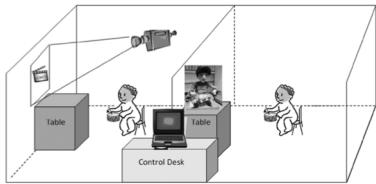
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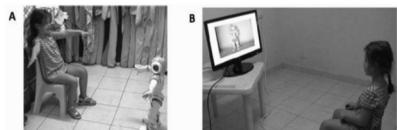
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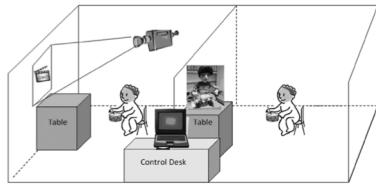
Thellman et al. 2015



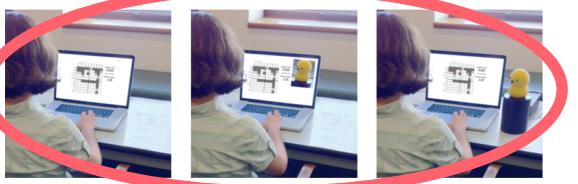
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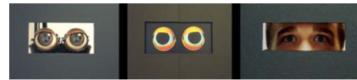
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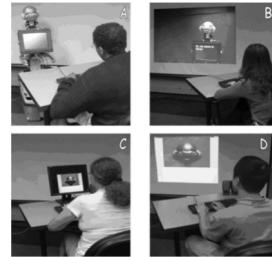
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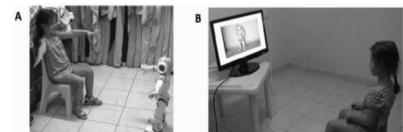
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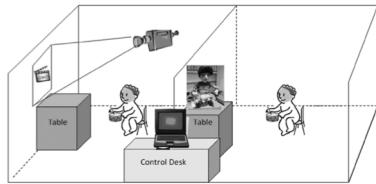
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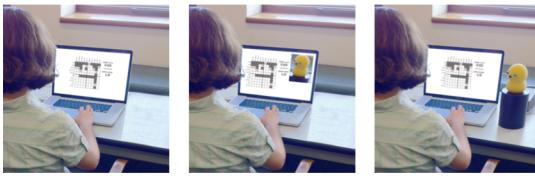
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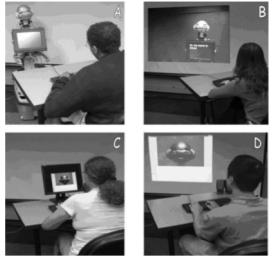
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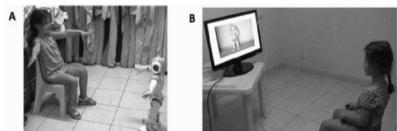
Bainbridge et al. 2010



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Kim et al. 2017



Lighthart & Truong 2015



Thellman et al. 2015



Kontogiorgos et al. 2019

Research Questions

What is the impact of embodied affordances
of socially interactive teammates
in a cooperative task?



Research Questions

- Is human disposition to cooperate different between teaming up with robots and with disembodied agents?



Research Questions

- Is human disposition to cooperate different between teaming up with robots and with disembodied agents?
- How would people perceive artificial teammates that do or do not cooperate with the team in favour of selfish actions? How will those perceptions be affected by their embodiment?



Task

- “For The Record”
- N-player collaborative game
- Variant of a Public Goods
- Musical metaphor

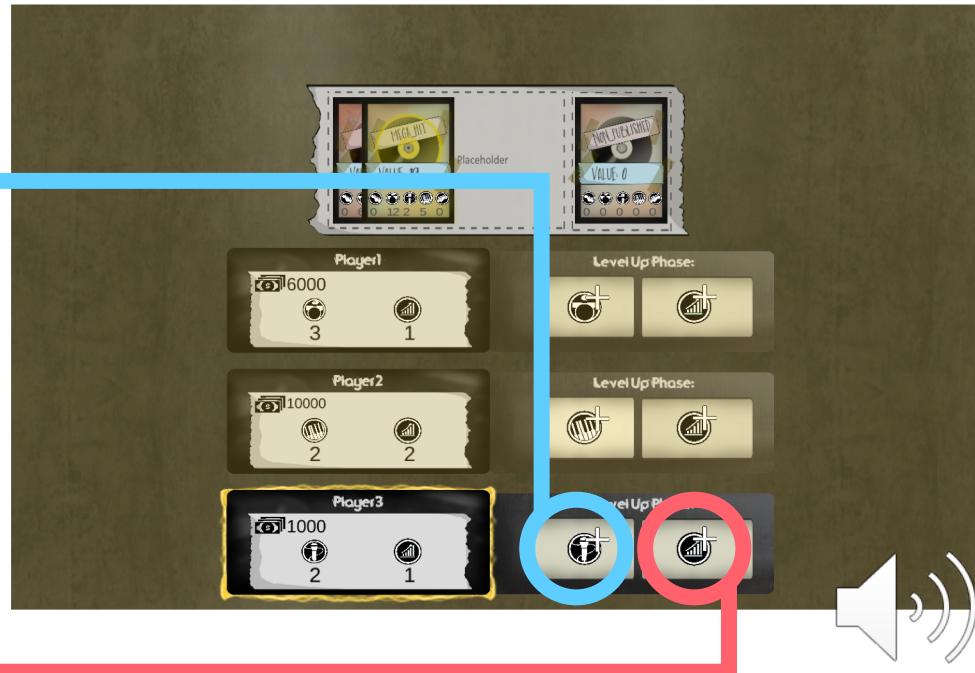


Task

to cooperate



to defect



User Study

3 independent variables:

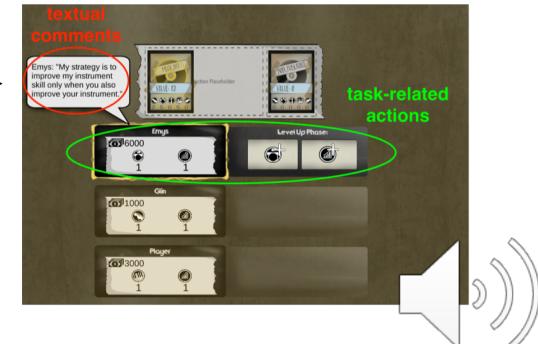
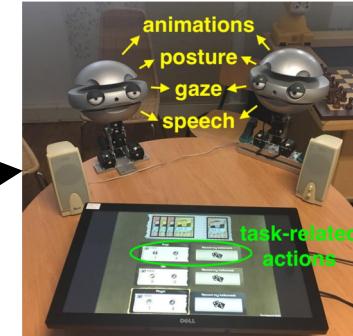
- Embodiment (between-subjects)
- Playing strategy of the agents (within-subjects)
- Outcome of game (between-subjects)



User Study

3 independent variables:

- Embodiment (between-subjects)
 - Robots
 - Disembodied agents
- Playing strategy of the agents (within-subjects)
- Outcome of game (between-subjects)



User Study

3 independent variables:

- Embodiment (between-subjects)
- Playing strategy of the agents (within-subjects)
 - Selfish
 - Prosocial
- Outcome of game (between-subjects)



User Study

3 independent variables:

- Embodiment (between-subjects)
- Playing strategy of the agents (within-subjects)
- Outcome of game (between-subjects)
 - The team wins
 - The team loses



Hypotheses

Cooperation¹ - Participants will be more prosocial in the embodied condition compared to the disembodied condition.



¹*Cooperation* was measured by the strategy participants took to play the social dilemma.

Hypotheses

Cooperation - Participants will be more prosocial in the embodied condition compared to the disembodied condition.

Perception of the team² - Participants will perceive the team more positively in the embodied condition compared to the disembodied condition.



²*Perception of the team* was measured with subjective scales of group identification and group trust.

Hypotheses

Cooperation - Participants will be more prosocial in the embodied condition compared to the disembodied condition.

Perception of the team - Participants will perceive the team more positively in the embodied condition compared to the disembodied condition.

Perception of the prosocial/selfish teammate³ - The perception of the prosocial and the selfish agents will be, respectively, more positive and more negative when it is embodied than when it is disembodied.



³*Perception of the teammates* was measured with subjective RoSAS scale.

Sample

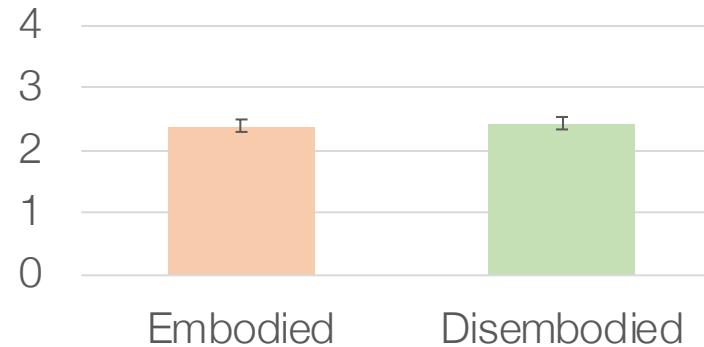
Total of 111 participants (age [22, 63], $M_{age} = 36.1 \pm 10.8$)

- 70 embodied condition
 - In-person recruitment
- 41 disembodied condition
 - Amazon Mechanical Turk



Results - Cooperation

Cooperation (out of 4 decisions)



No significant difference were observed between the cooperation of the two conditions of embodiment
($Z=-0.565, p= 0.572, r=0.055$)



Results - Perception of the team

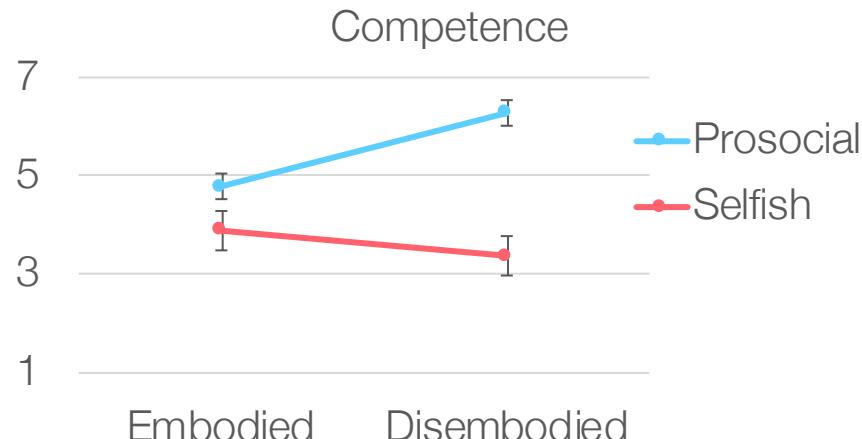
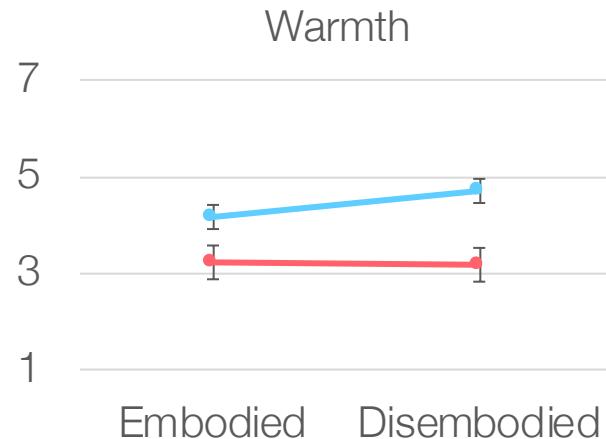


A significant main effect of
the embodiment on the
group identification
 $(F(1,106) = 15.589, p < 0.001, r = 0.358)$

No significant effect of
embodiment was found for
group trust
 $(F(1,106) = 0.423, p = 0.517, r = 0.063)$



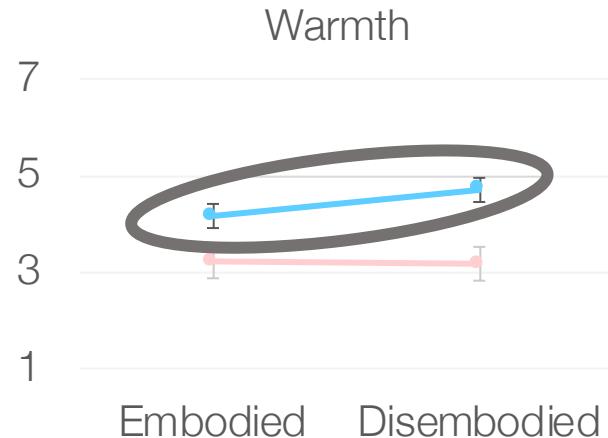
Results - Perception of the teammates



A significant **interaction effect** between the *strategy* and the *embodiment* on the perception of **warmth**
($F(1,106) = 4.566, p=0.035, r= 0.202$)

A significant **interaction effect** between the *strategy* and the *embodiment* on the perception of **competence**
($F(1,106) = 41.909, p= 0.001, r= 0.532$)

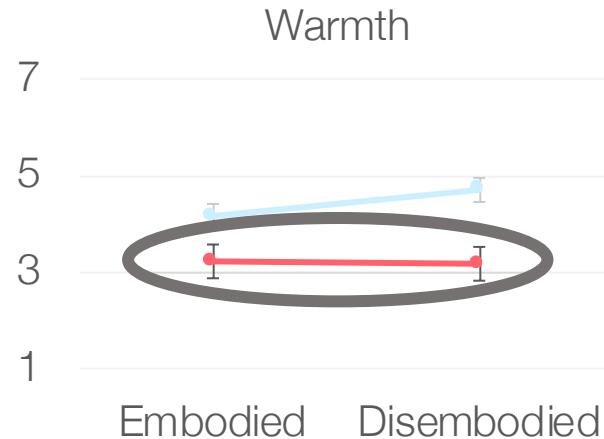
Results - Perception of the prosocial



The warmth and competence attributed to the **prosocial** agent was significantly different for each type of embodiment
($U=1089$, $Z=-2.015$, $p=0.044$, $r=0.192$; $U=449.5$, $Z=-5.974$, $p<0.001$, $r=0.570$, respectively)



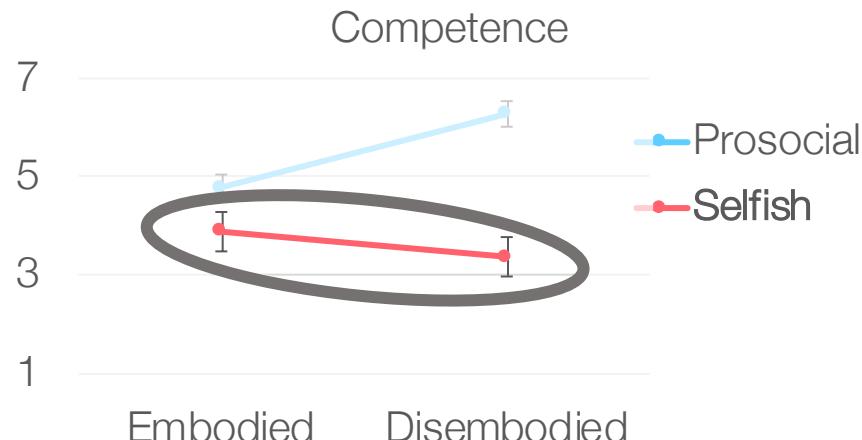
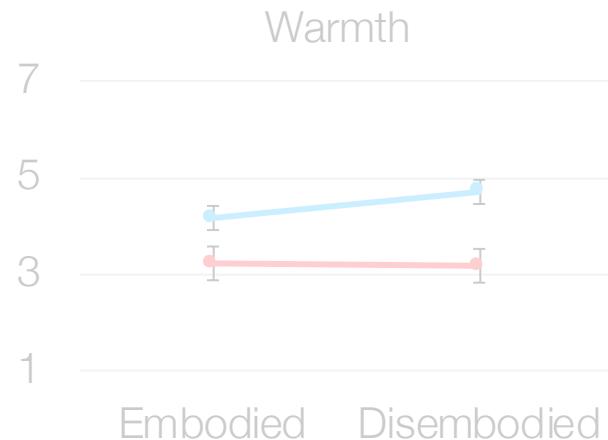
Results - Perception of the selfish



The warmth attributed to the **selfish** agent was not significantly different for each type of embodiment
($U=1407$, $Z=-0.171$, $p=0.864$, $r=0.016$)



Results - Perception of the **selfish**



The competence attributed to the **selfish** agent was significantly different for each type of embodiment
($U=1049$, $Z=-2.373$, $p=0.018$, $r=0.225$)

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- Contrary to our hypothesis, participants were not more cooperative in the embodied condition, nor did they trust their team more compared to having disembodied teammates.
 - Relation between trust and cooperation
 - Presence of unconditional defector



Discussion

- Participants perceived the **prosocial** more negatively when it was **embodied** compared to when it was disembodied.
- Participants perceived the **selfish** more positively when it was **embodied** compared to when it was disembodied.



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 - The presence of an embodiment introduces (social) factors into the evaluation of an agent.



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