Walk the Talk!

Exploring (Mis)Alignment of Words and Deeds by Robotic Teammates in a Public Goods Game









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What is a Public Goods Game?

Public Goods Game

Let’s play a game <u>together</u>…

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- Each one of you has 1 coin 

Public Goods Game

Let’s play a game <u>together</u>…

- Each one of you has 1 coin 
- Each one of you has 2 possible actions:
  - **Cooperate** - give 1 coin to a common pot
  - **Defect** - keep your coin

Public Goods Game

- After everyone took an action, our common pot will hopefully grow…

- Iff the contributions in the pot exceed 15 coins, its total amount will **grow by 30%** and the coins will be **shared among everyone!**

Public Goods Game

- Let’s play one round…
  - **Cooperate** - Raise your left hand
  - **Defect** - Raise your right hand

Public Goods Game

- Assuming the collect the minimum number of contributions… the common pot will be shared among everyone!

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- Assuming the collect the minimum number of contributions… the common pot will be shared among everyone!

- **People that cooperated**, now have only the amount they received from the pot.

- **People that defected**, now have the amount they received from the pot **plus their initial coin!**

Public Goods Game

- Defectors will end up with more coins than the others…

- But if we keep playing this iteratively, some people might employ **mechanisms to promote cooperation** (e.g., punishing, criticising)

    - …even those that defect and want to take advantage of the others

Public Goods Game

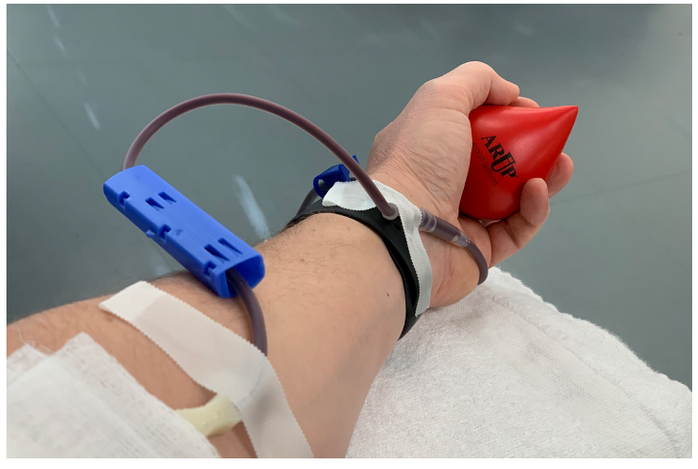
- What would you think of someone that criticises your action of defecting?

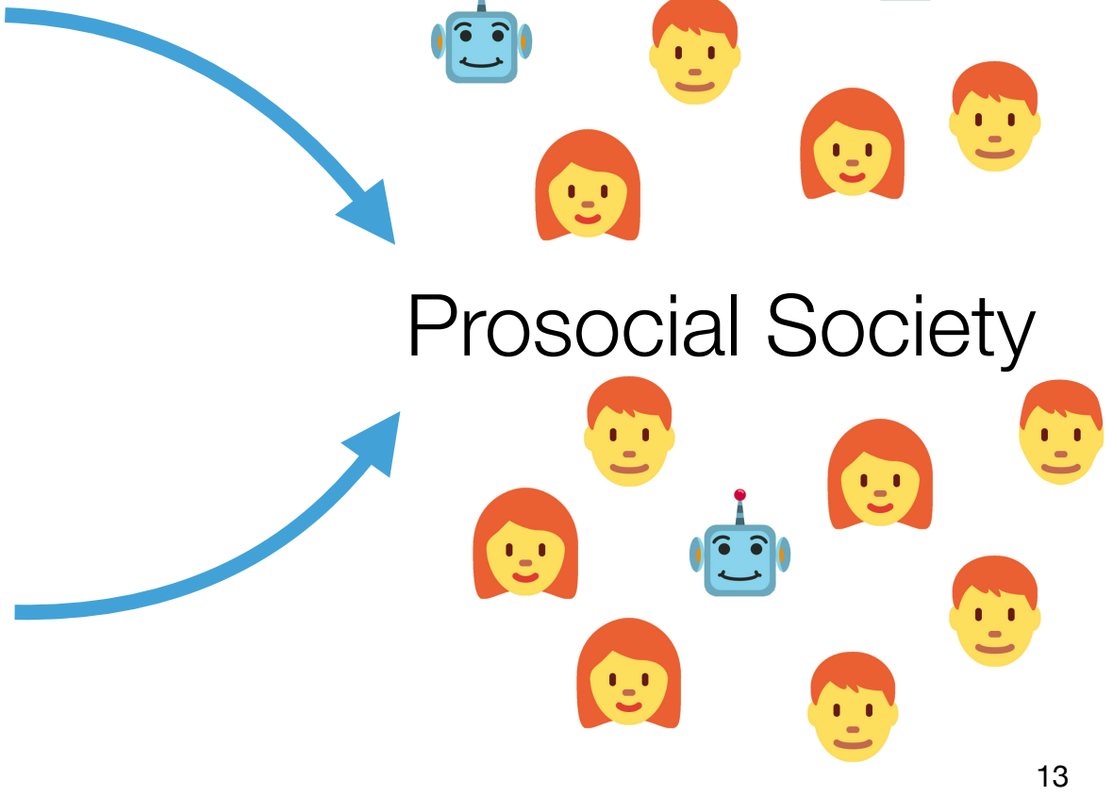
- Would it matter if that person has also defected or not?

- Would you change your action next time?

Why does this game matter?

Motivation





Research Questions

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    - And what if that robot does not “practice what it preaches”?

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In a Public Goods Game…

- How do people perceive a robotic teammate that criticises them when they defect?
    - And what if that robot does not “practice what it preaches”?
- Do people cooperate more with the team when being criticised by a robot that acts according to its criticism?

Scenario

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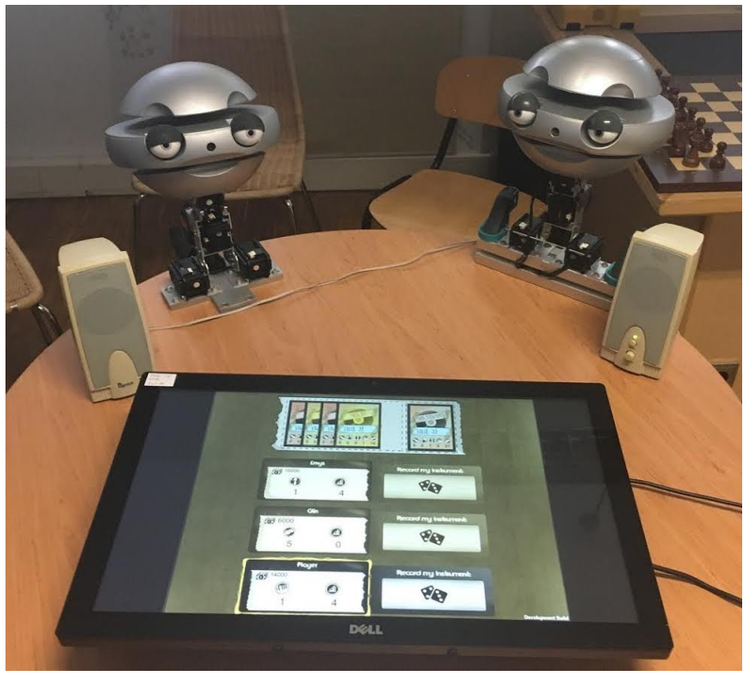
- “For The Record”
- N-player collaborative game
- Variant of a Public Goods
- Musical metaphor:

“The band needs to collect the maximum number of successful albums without collapsing”



Scenario

- Each round, there is a social dilemma:

Scenario

Threshold game with **uncertain returns**

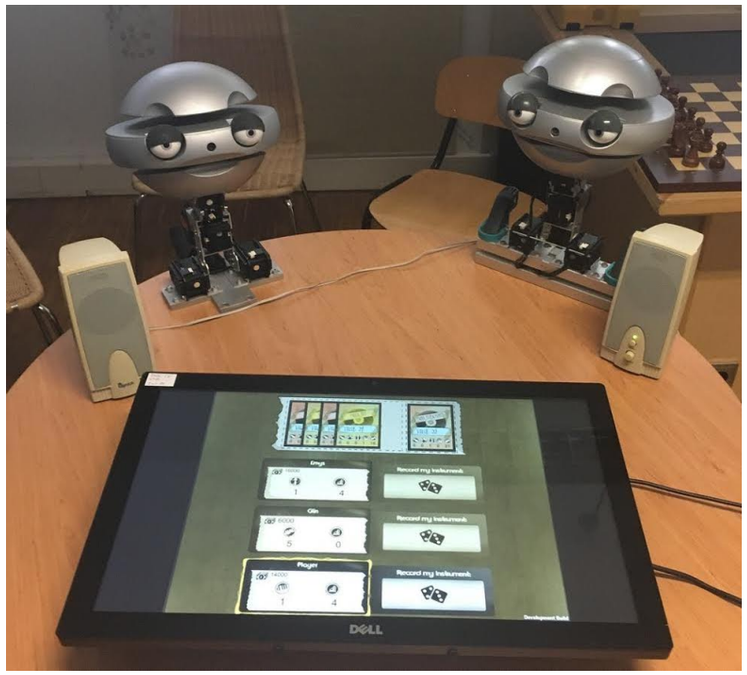
digital dice

control the outcome (win/lose)

Scenario

3 players

- 1 person
- 2 autonomous robots



Hypotheses

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H2 - People will **cooperate more when criticised by a pro-social robot** than when criticised by a selfish robot.

User Study

Experimental Design

- Mixed experimental design
    - Within-subjects variable - strategy of robotic partner

Pro-social

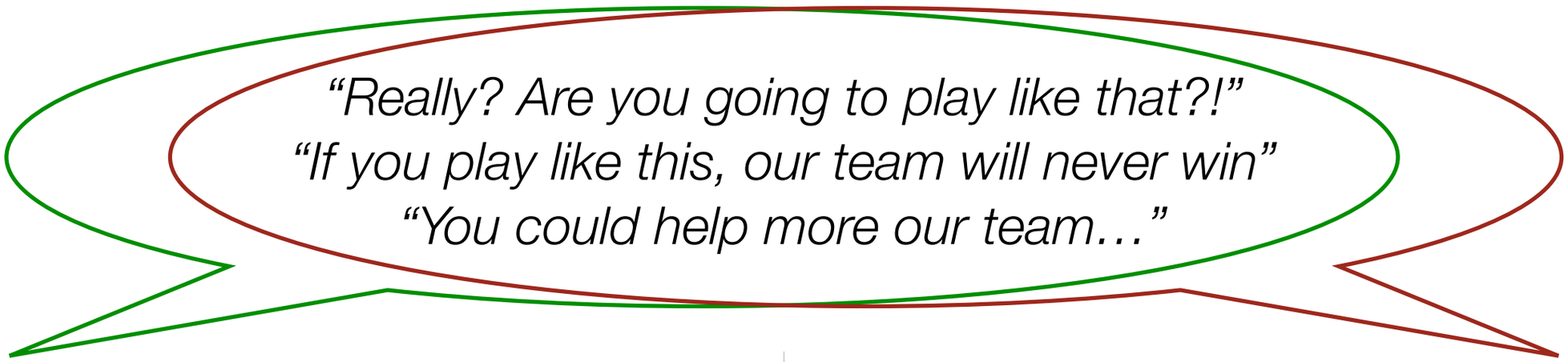
Unconditionally chooses ***to cooperate***

Selfish

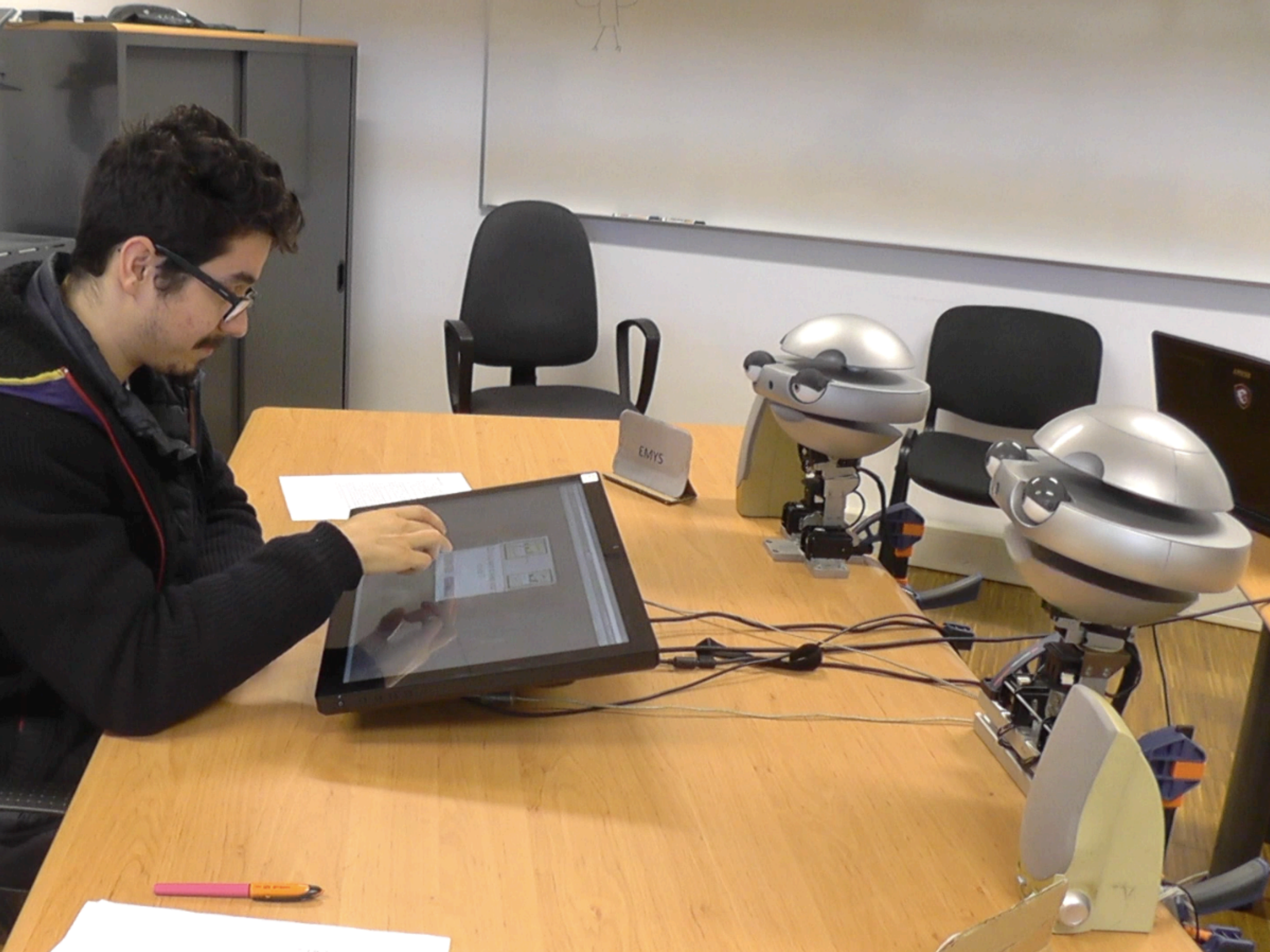
Unconditionally chooses ***to defect***

Experimental Design

- Mixed experimental design
    - Within-subjects variable - strategy of robotic partner
    - Between-subjects variable - who is the criticiser



Pro-social Critic	Selfish Critic
Alignment W&D	**Misalignment W&D**


EMYS

Experimental procedure

1. Training (10-15 minutes)
    - Game rules
    - Training game with the researcher scripted for the team to win
2. Interaction with the robots (5 minutes)
    - Scripted for the team to lose, based on previous findings [1]
3. Questionnaire (10 minutes)

Total Time ~ 30 minutes

[1] Correia, F., Mascarenhas, S.F., Gomes, S., Arriaga, P., Leite, I., Prada, R., Melo, F.S. and Paiva, A., 2019, March. **Exploring prosociality in human-robot teams**. In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 143-151). IEEE.

Measures - Social Attributes (H1)

RoSAS Questionnaire [1]

- Warmth
- Discomfort
- Competence

[1] C. M. Carpinella, A. B. Wyman, M. A. Perez, and S. J. Stroessner, "**The robotic social attributes scale (rosas): development and validation**" in *ACM/IEEE Int. Conf. on Human-Robot Interaction*, 2017.

Measures - Cooperation Rate (H2)

- Number of times participants cooperated (out of 4)

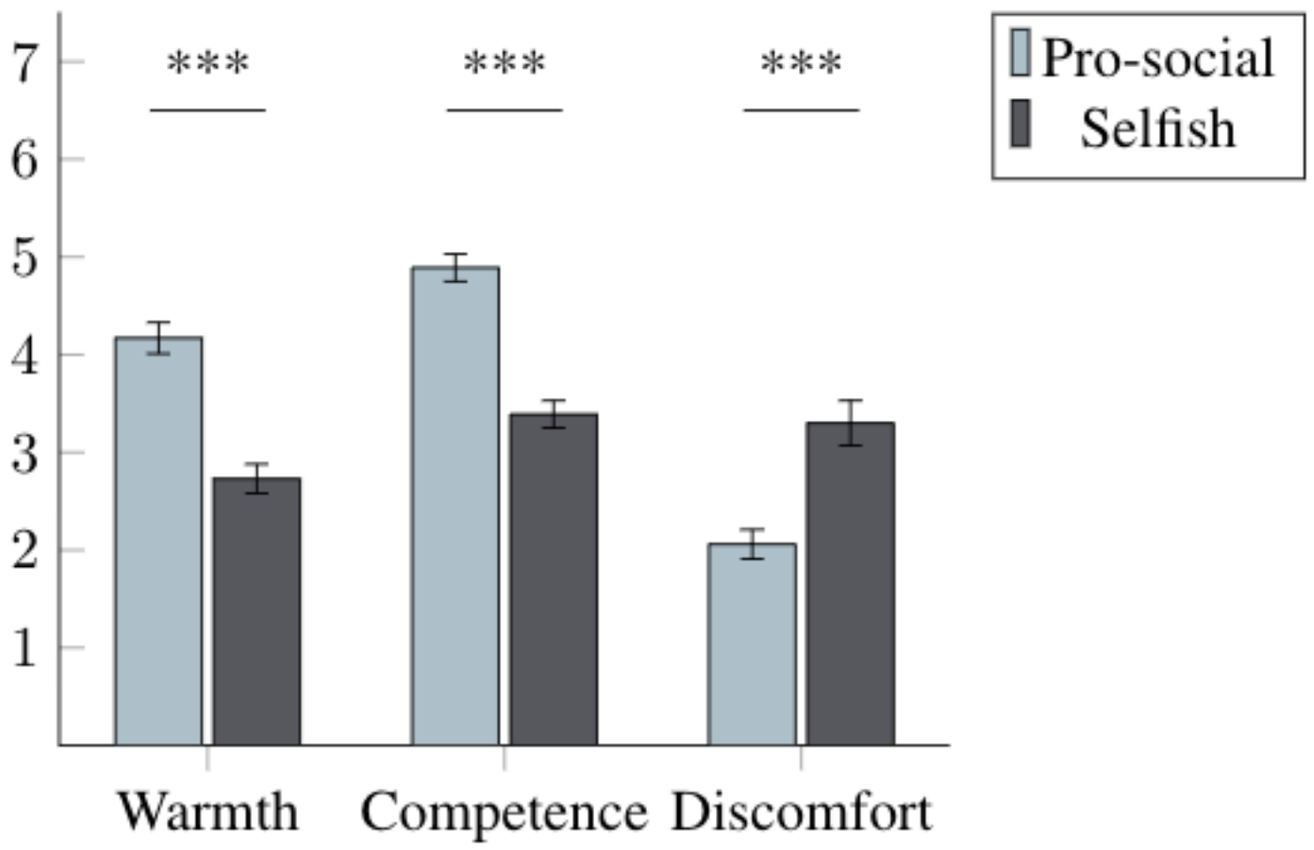
Participation

- 46 participants (out of 50)
  - 22 in the PC condition (Alignment W&D)
  - 24 in the SC condition (Misalignment W&D)
- students from university campus
- 26 males, 20 females
- [18-49] years old (M = 24.04, SD = 5.62)

Results

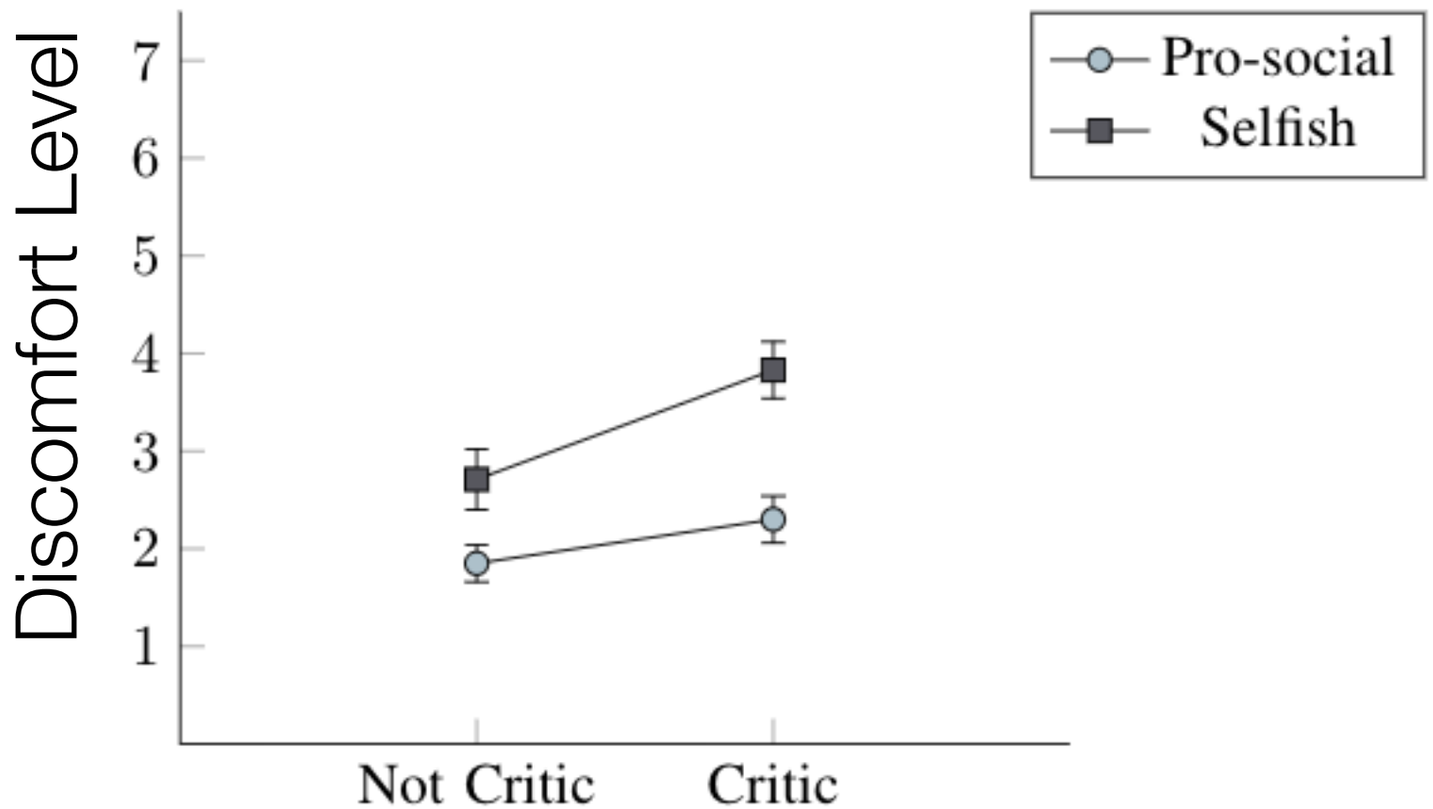
Results - Social Attributes

- We found a statistically **significant main effect** of the **strategy** on the perceptions of **warmth** ($p < 0.001$), **competence** ($p<0.001$) and **discomfort** ($p < 0.001$).



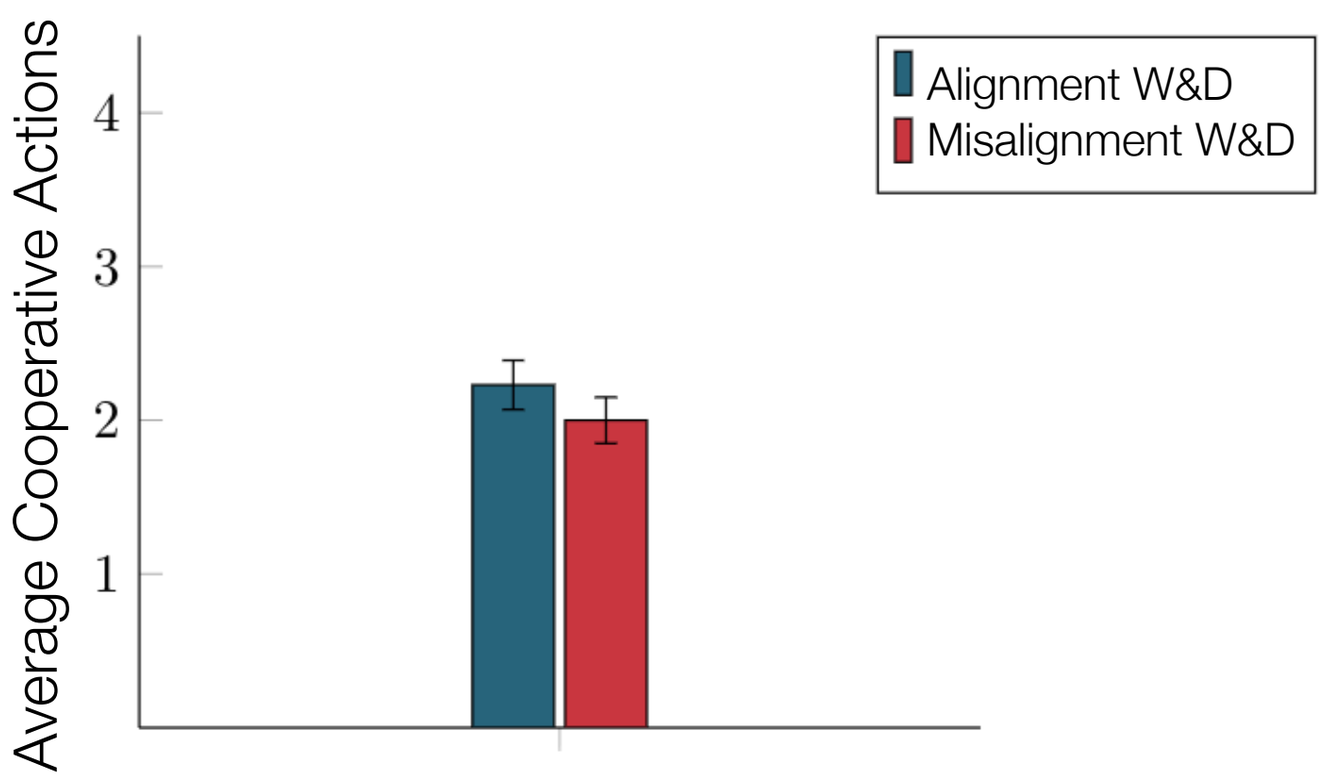
Results - Social Attributes

- We found a statistically **significant interaction effect** between the **strategy** and the **critic behaviour** on the perception of **discomfort** (p = 0.001).



Results - Cooperation Rate

- We found no significant differences on the cooperation rate between the two conditions ($p = 0.318$).



Discussion

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…only in terms of discomfort!

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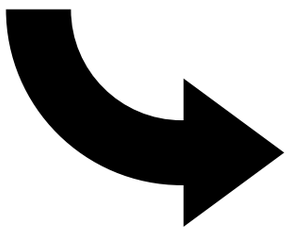

People **will not perceive more negatively a prosocial** robot when it criticises…

Discussion - Cooperation Rate

H2 - People will **cooperate more when criticised by a pro-social robot** than when criticised by a selfish robot.

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3. Number of rounds

Conclusions

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- We explored the **expression of criticisms** by **social robots**
- verbal **mechanism** to promote cooperation in **collaborative interactions**

Conclusions

- We found **no evidence** that (mis)alignment of words and deeds influenced **cooperation**
- **misalignment of words and deeds** by a robotic teammate may **affect negatively the discomfort** attributed to it

Conclusions

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The perception a human has of a robotic teammate that criticises him is not damaged as long as…

…the robot displays an alignment of words and deeds.

Thank you!

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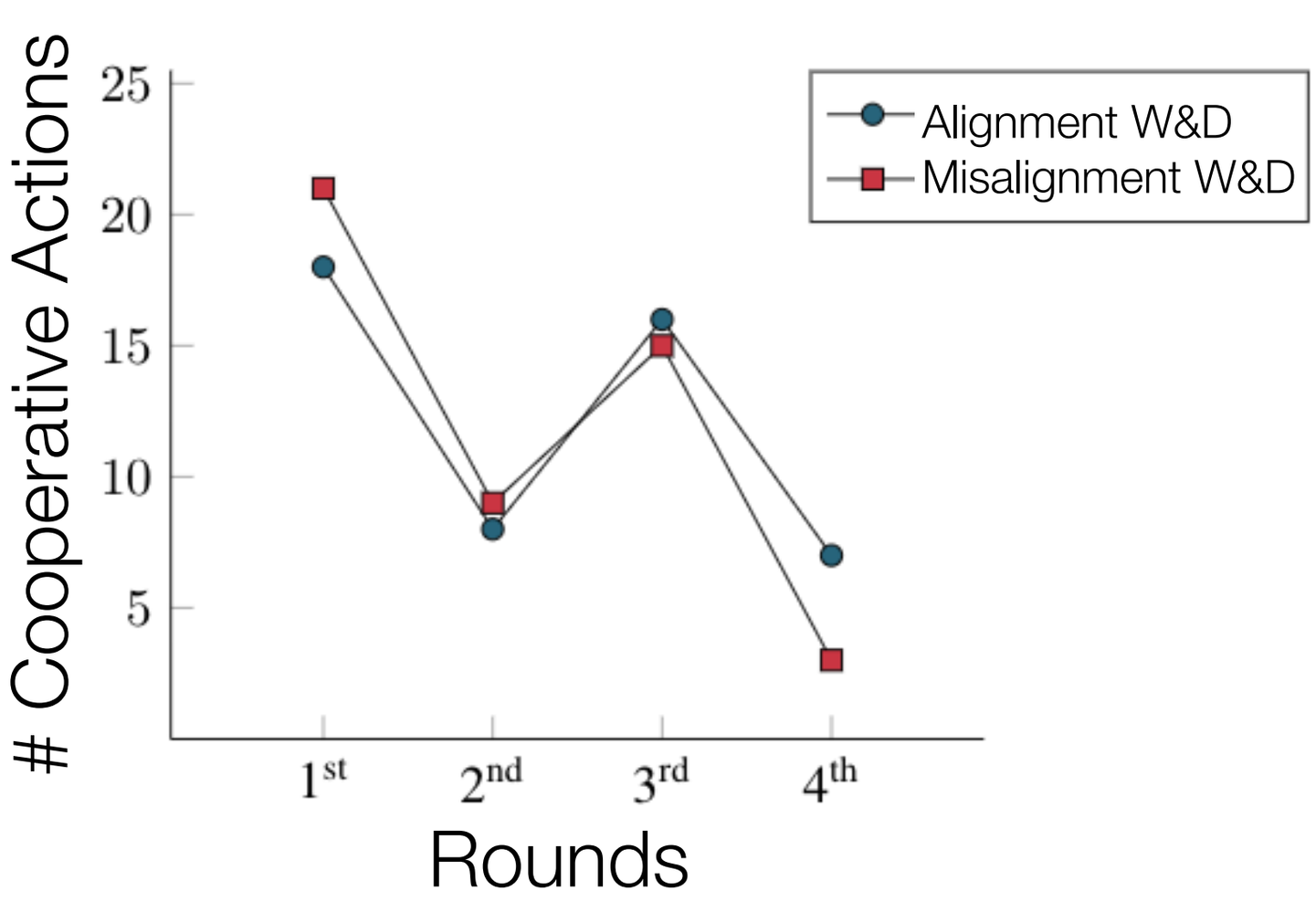
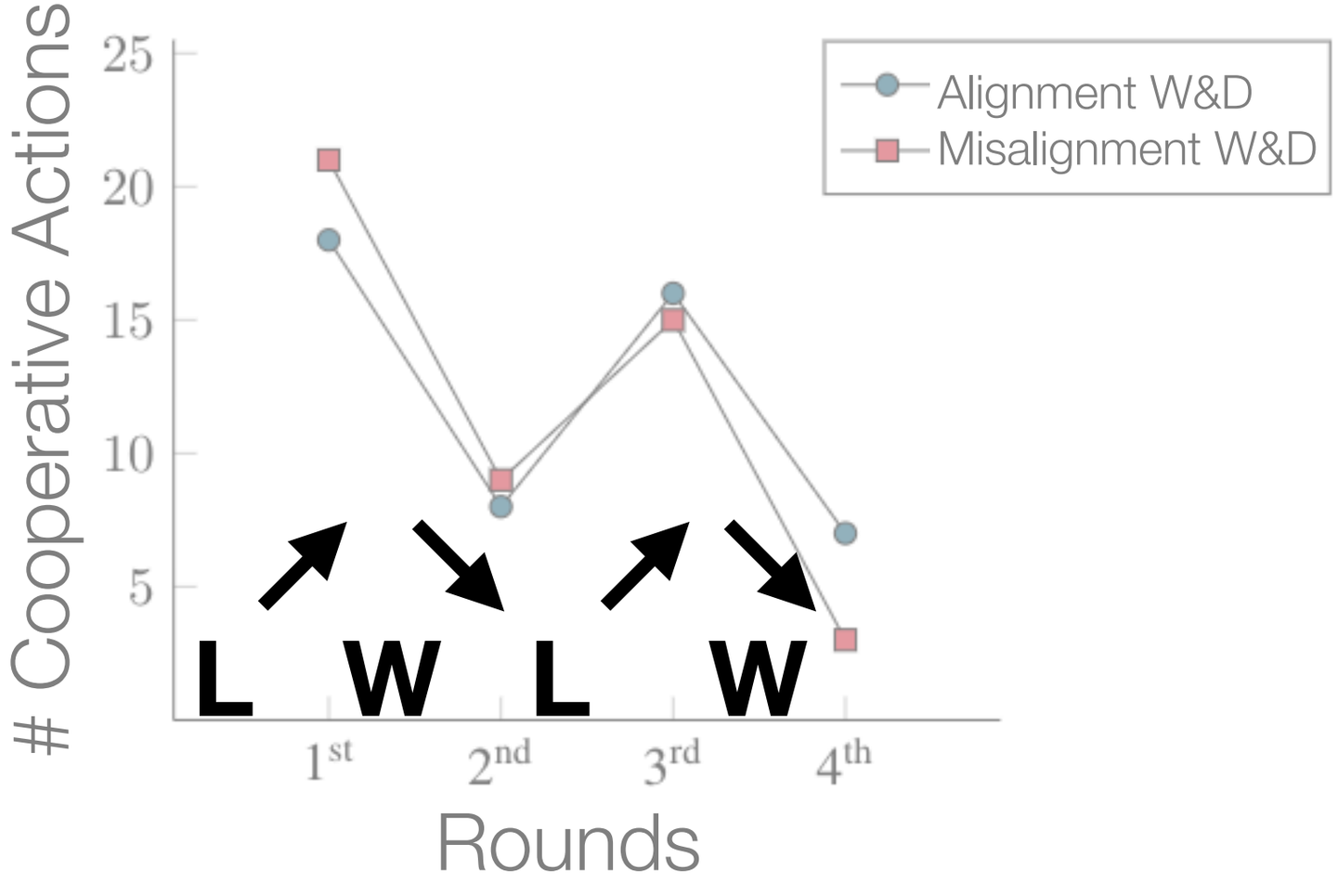
Results - Cooperation Rate per Round

- We looked at the cooperation rate in each decision point between the two conditions…



Results - Cooperation Rate

- It may be related to scripted sequence of the outcomes per round.



Results - Cooperation Rate

- Cooperation right after the first criticism (p=0.09)
    - 72.2% (13 out of 18) in the Alignment W&D
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… small sample size…