

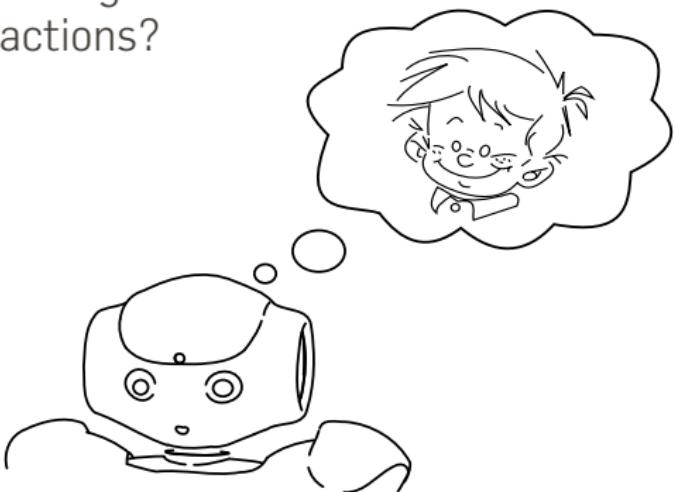
Mutual Modelling in Educational Child-Robot Interaction

Does a second level of modelling
enable higher quality interactions?

EDRS candidacy exam

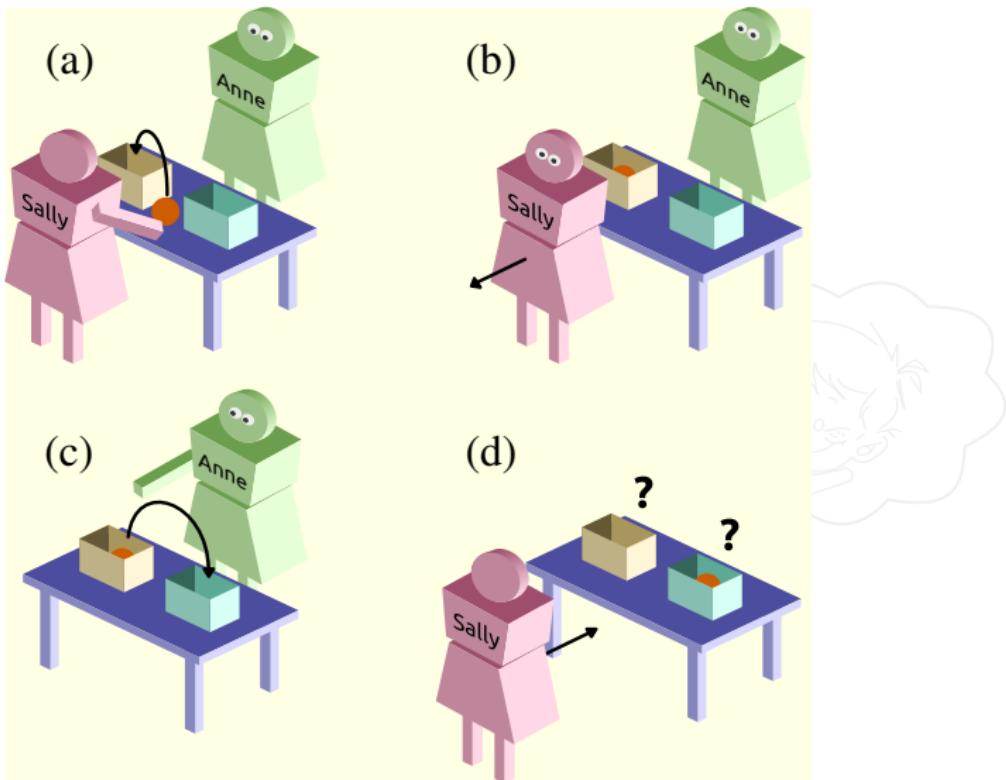
Alexis D. Jacq

Computer-Human Interaction
for Learning and Instruction **EPFL**
& Instituto Superior Técnico
University of Lisbon

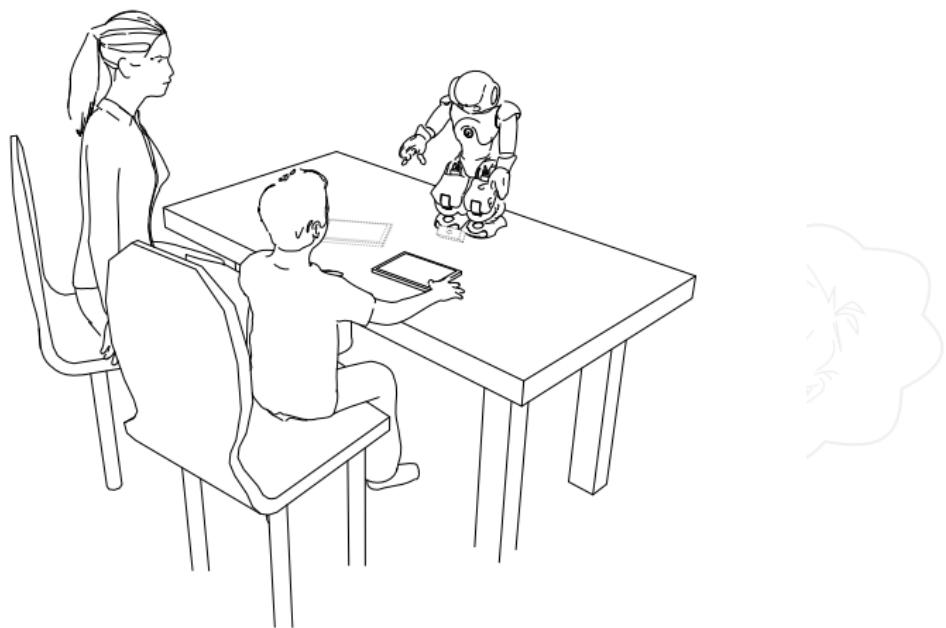


INTRODUCTION

MUTUAL MODELLING IN HRI



THE COWRITER ACTIVITY



FRAMEWORK

DEFINITIONS

- 1st-order agents
- 2nd-order agents
- nth-order agents



DEFINITIONS

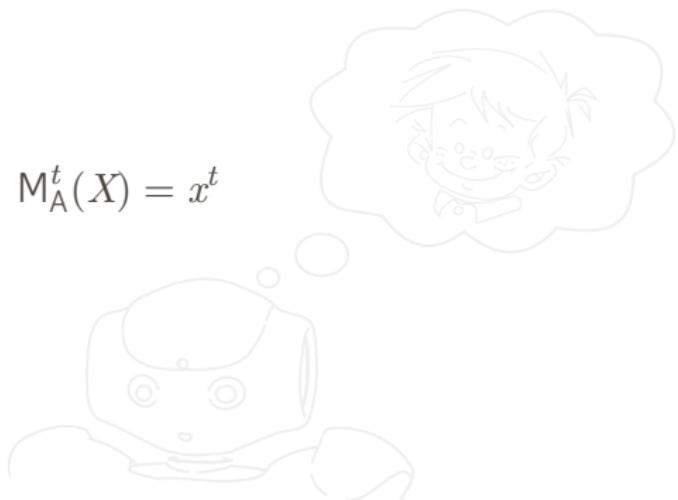
- perceived variables
- abstract variables
- model of an agent



NOTATIONS

- o M_A
- o $M_{A,B}$
- o $M_{A,B,C,D}$
- o

$$M_A^t(X) = x^t$$



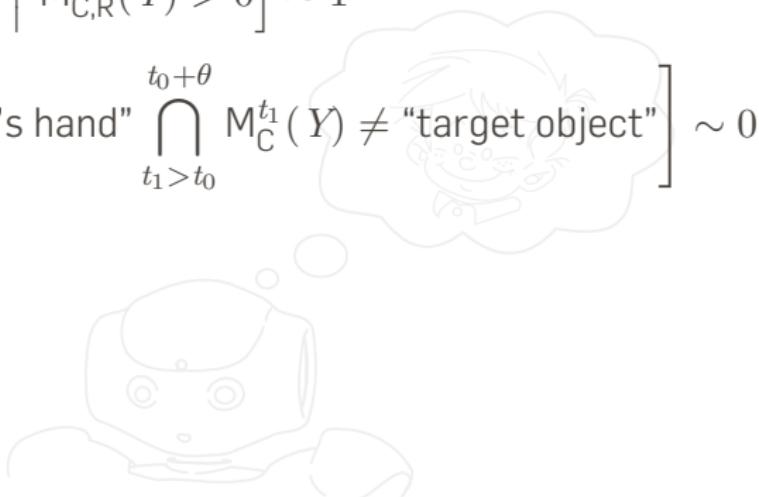
EXPECTED CAUSALITIES

$$\mathbb{P} [\text{mental state} \mid \text{behaviour}]$$
$$\mathbb{P} [\text{abstract variables} \mid \text{perceived variables}]$$


EXPECTED CAUSALITIES

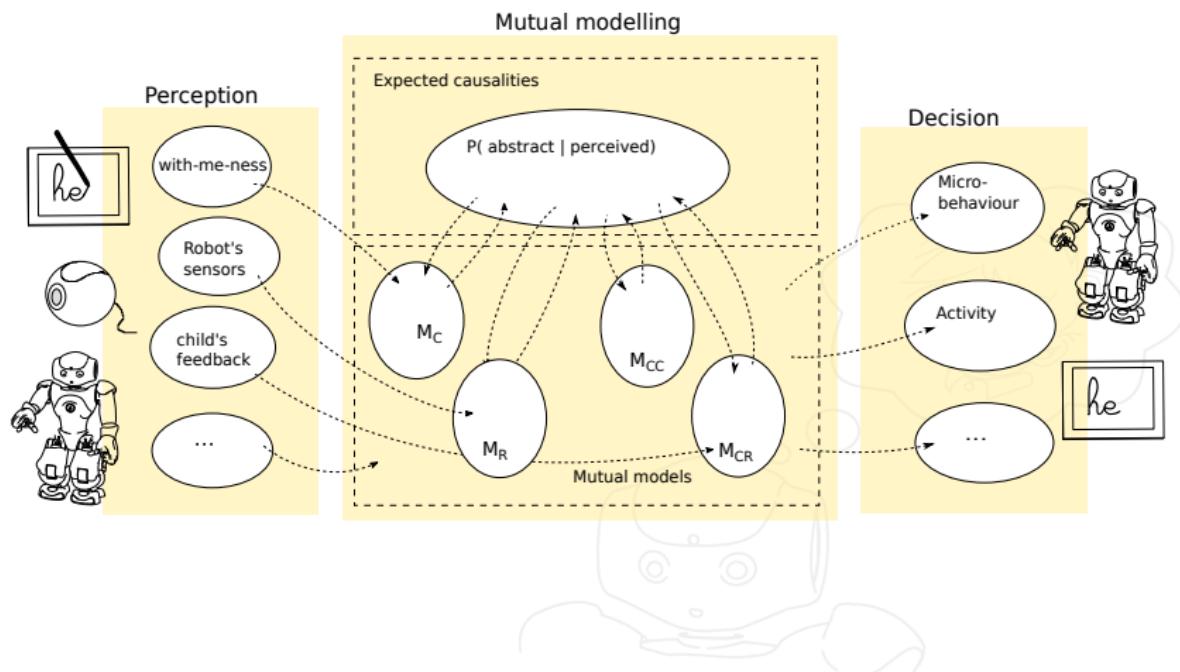
$$\mathbb{P} \left[M_{C,R}^t(X) \mid M_{C,R}^t(Y) > 0 \right] \sim 1$$

$$\mathbb{P} \left[M_C^{t_0}(X) \mid M_C^{t_0}(Y) = \text{"robot's hand"} \bigcap_{t_1 > t_0}^{t_0 + \theta} M_C^{t_1}(Y) \neq \text{"target object"} \right] \sim 0$$



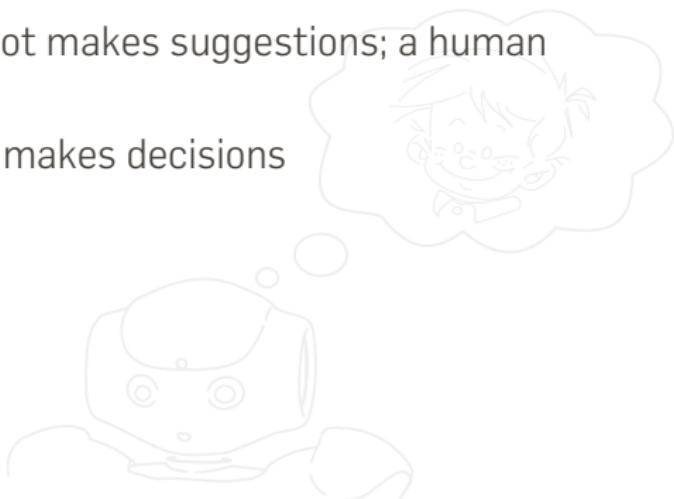
COGNITIVE ARCHITECTURE

GLOBAL DESCRIPTION



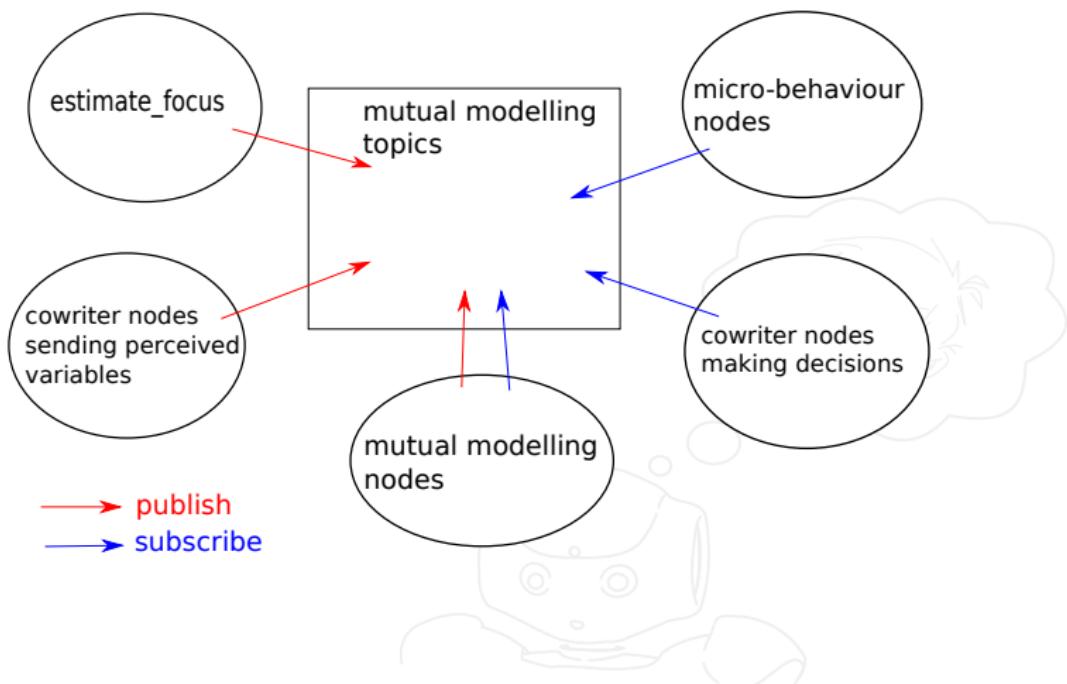
DECISION MAKING

1. **Wizard-of-Oz**: A human takes decisions; the robot learns
2. **Mixed-initiative**: The robot makes suggestions; a human agrees or disagrees
3. **Autonomous**: The robot makes decisions



IMPLEMENTATION

ROS NODES



EVALUATION

HYPOTHESIS

- Decisions made using additive information from second level of mutual modelling improve the quality of the CoWriter interaction.



QUALITY OF THE INTERACTION ?

1. Quantity of demos
2. Time spent to write demos
3. Progress of child/robot
4. With-me-ness
5. Feedback buttons



EXPERIMENTAL STUDIES

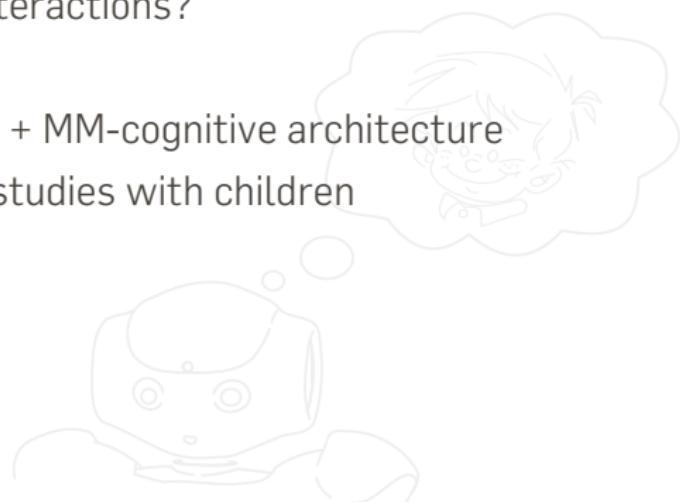
- Long-term studies
- Children with real deficits
- Professional facilitators



CONCLUSION & PLANNING

REMIND

1. **Question:** Does a second level of modelling enable higher quality interactions?
2. **Hypothesis:** Yes.
3. **Tools:** CoWriter activity + MM-cognitive architecture
4. **Evaluation:** Long-term studies with children



STEP BY STEP APPROACH

- New variable (or group of variables)
- New experiment to test the impact

