



**UWE  
Bristol**

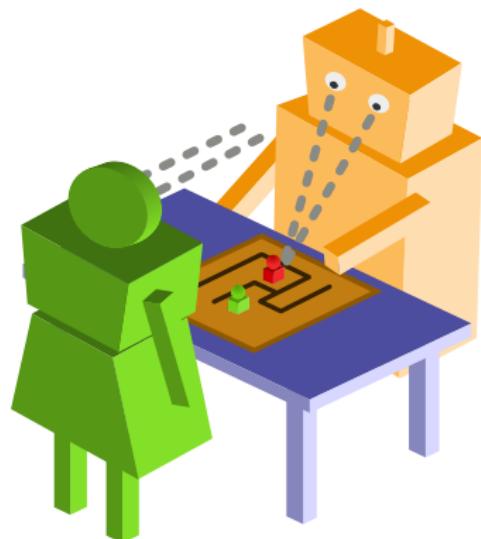
University  
of the  
West of  
England

# Socially-driven Autonomous Robots for Real-World Human-Robot Interactions

ISIR – 06 Jan 2021

Séverin Lemaignan

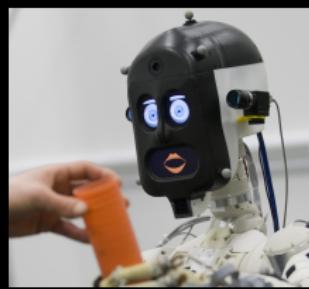
Bristol Robotics Lab  
**University of the West of England**





# ASSOCIATE PROF IN SOCIAL ROBOTICS AND AI

- Main community: Human-Robot Interaction
- Supervising 2 groups at BRL (embodied cognition and autonomous vehicles),  $\approx 15$  researchers
- Supervised or co-supervised 9 PhDs to date
- Programme committee/editorial board of FrontiersIn Robotics and AI; HRI; RSS; IROS; IJCAI
- 75+ publications, mostly in HRI (2700+ citations, i-index=26 on Google Scholar)
- Significant technical contributions (ROS, large datasets, 150+ repos on Github)

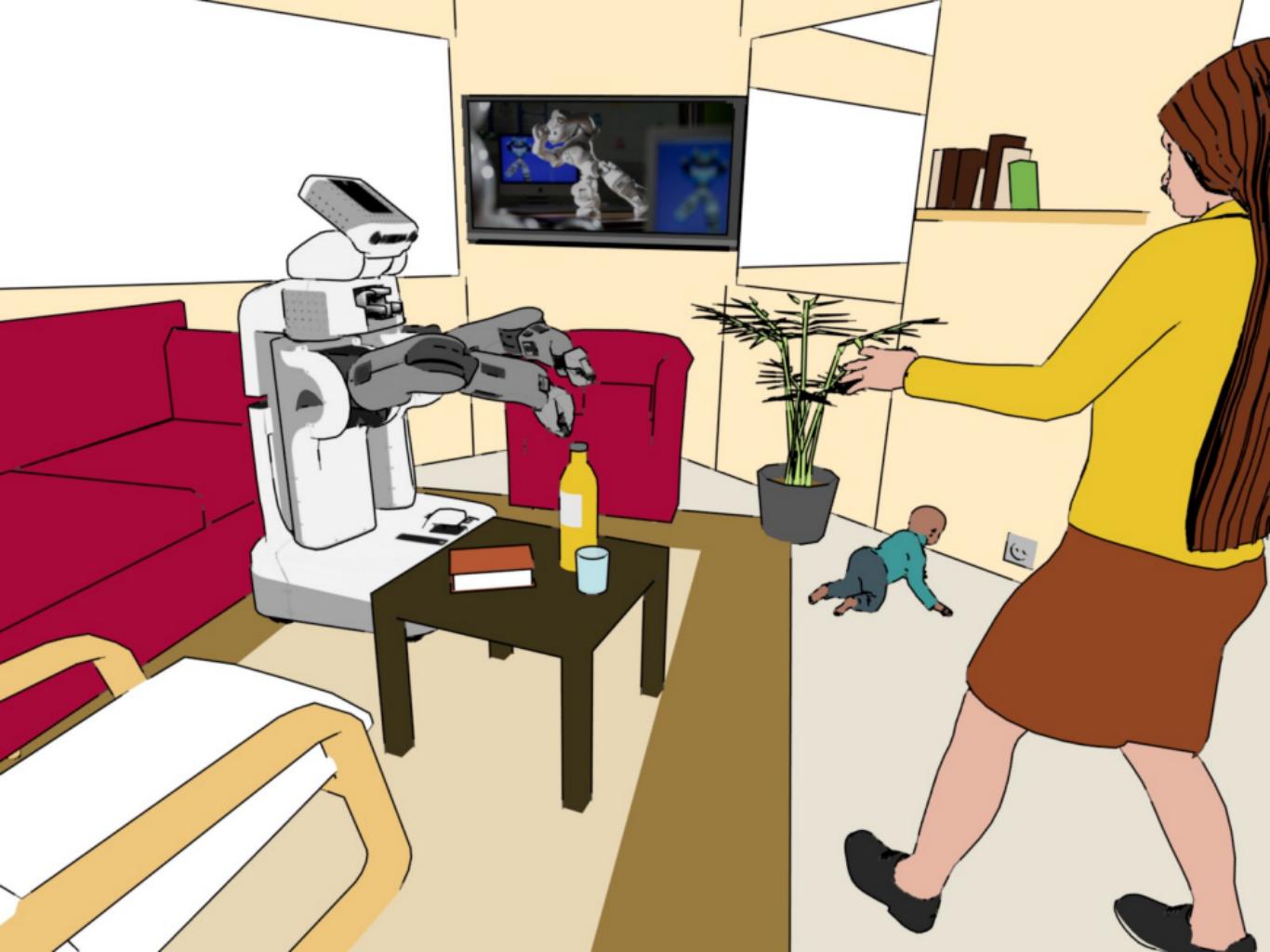


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- **...love field experiments!**



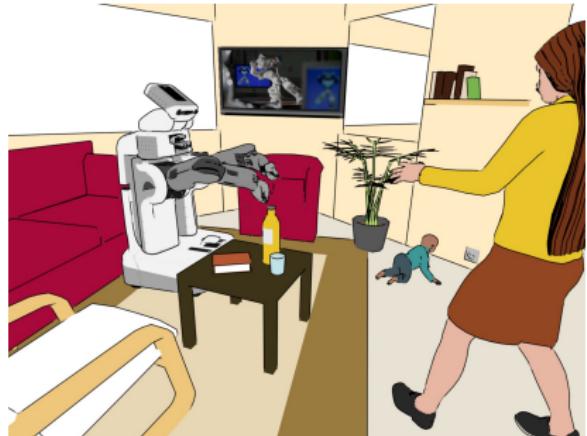
FROM SYMBOLIC SOCIAL COGNITION...



**Situated dialogue** effectively evidences the challenges

How can the robot make sense  
of and act upon a command like:

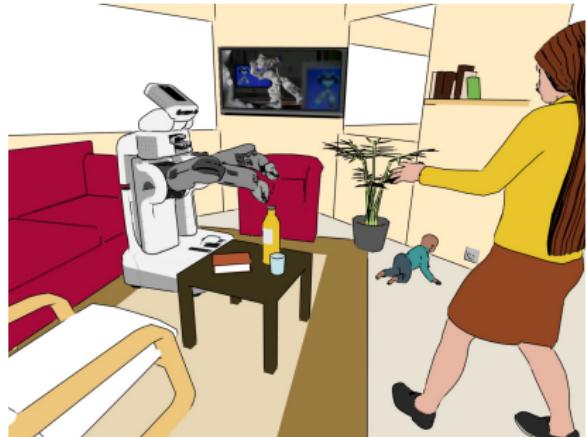
**“Can you give me that book?”**



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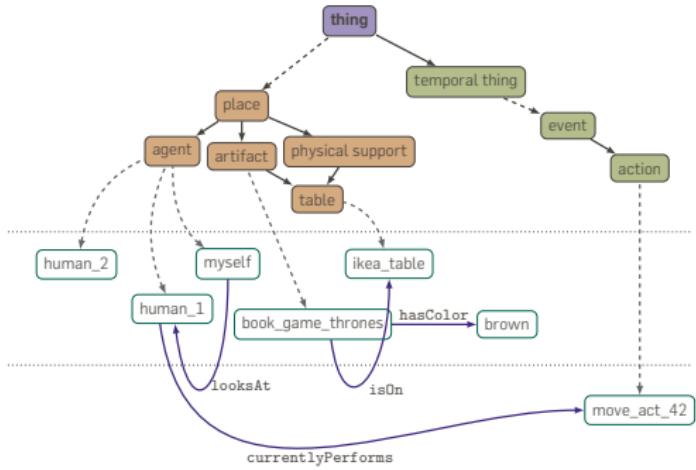
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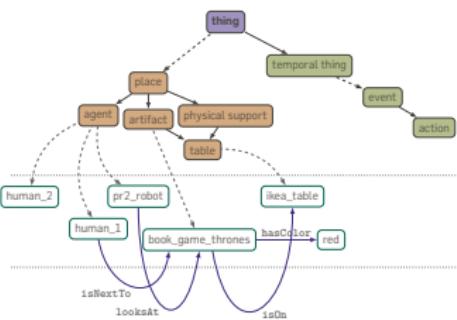
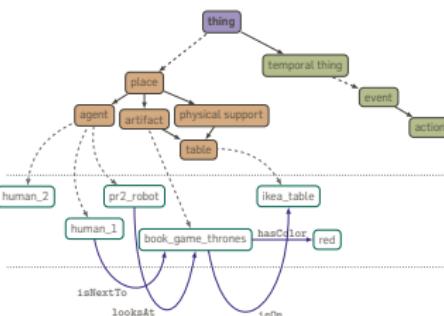
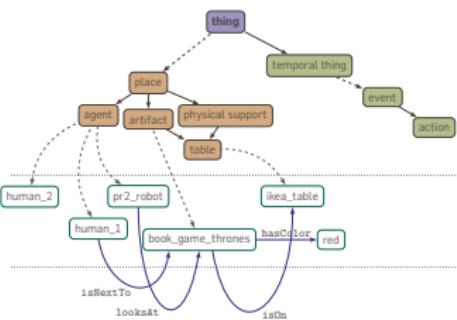


My PhD: a symbolic approach to this problem

# MULTI-MODAL SYMBOLIC SITUATION ASSESSMENT

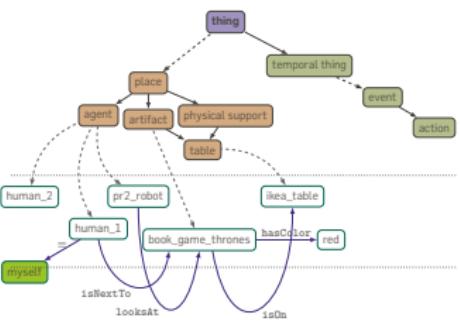
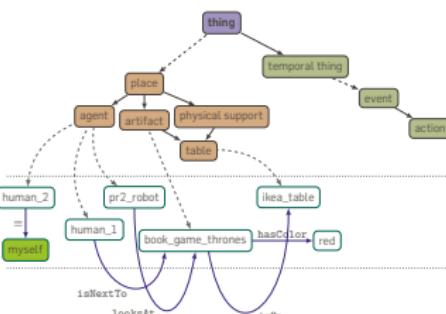
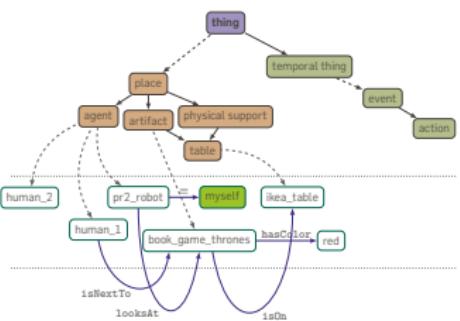


# MUTUAL MODELS



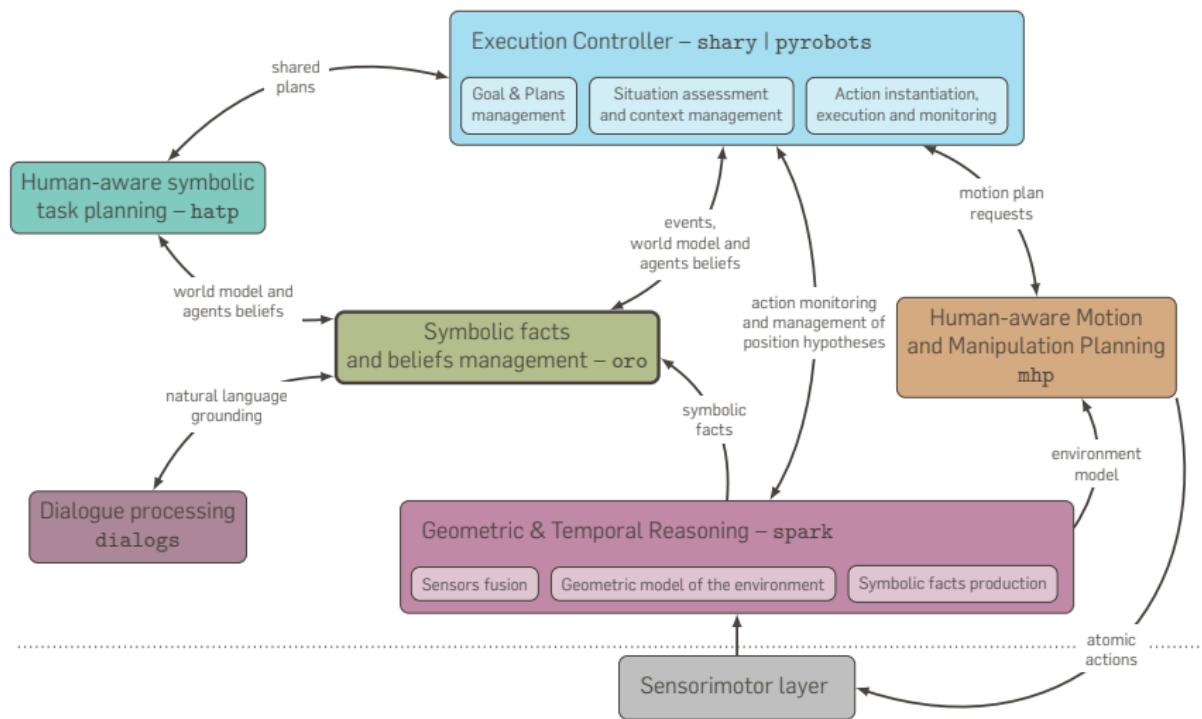
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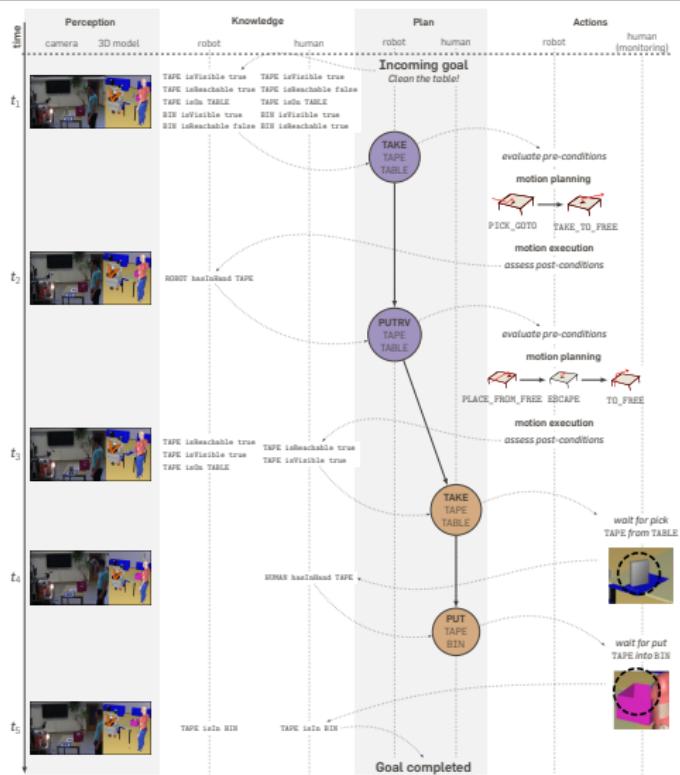


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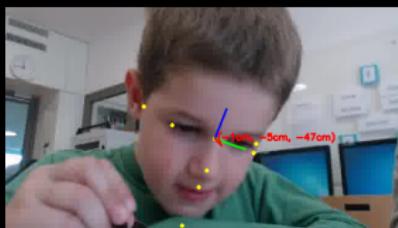
# AN ARCHITECTURE FOR SOCIAL & AUTONOMOUS INTERACTION



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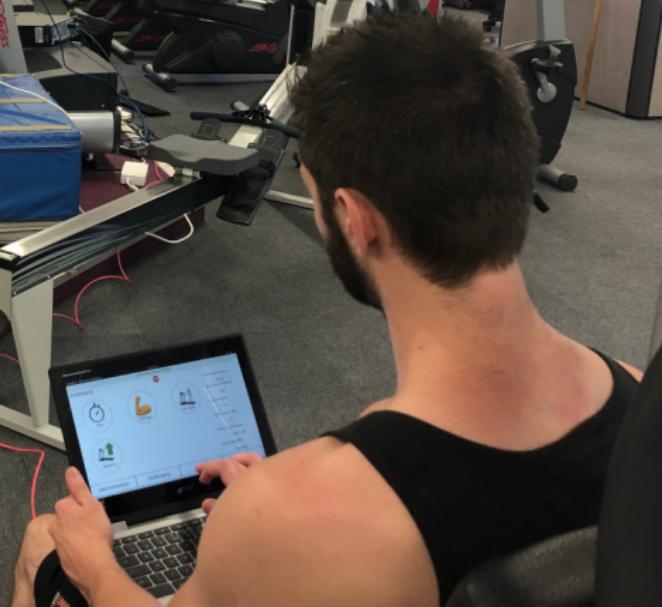


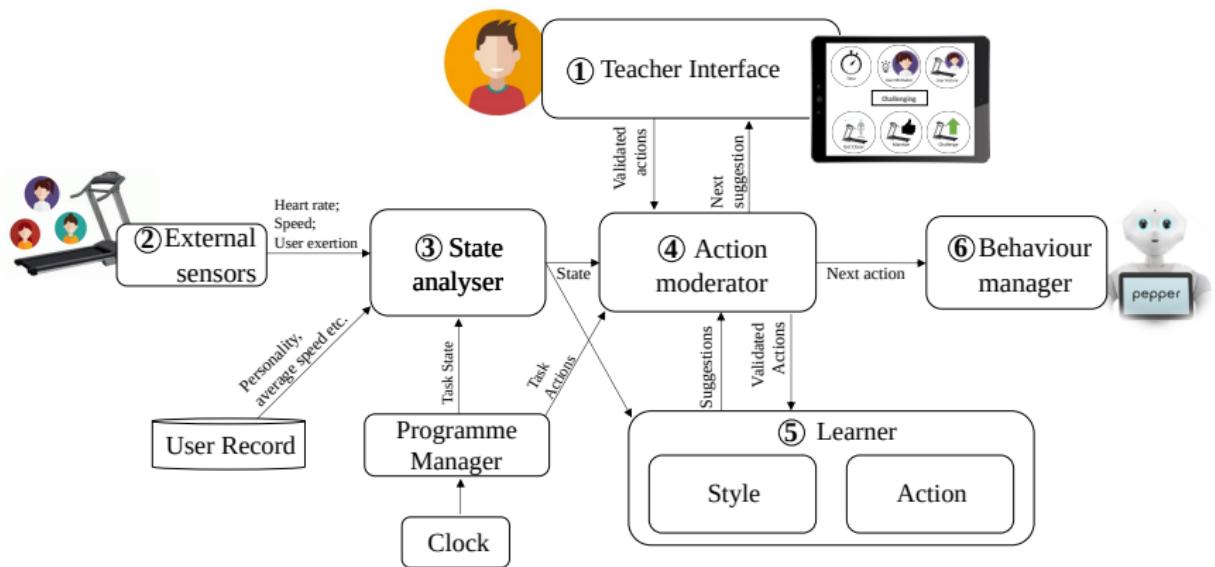
...TO CHILD-ROBOT INTERACTION...

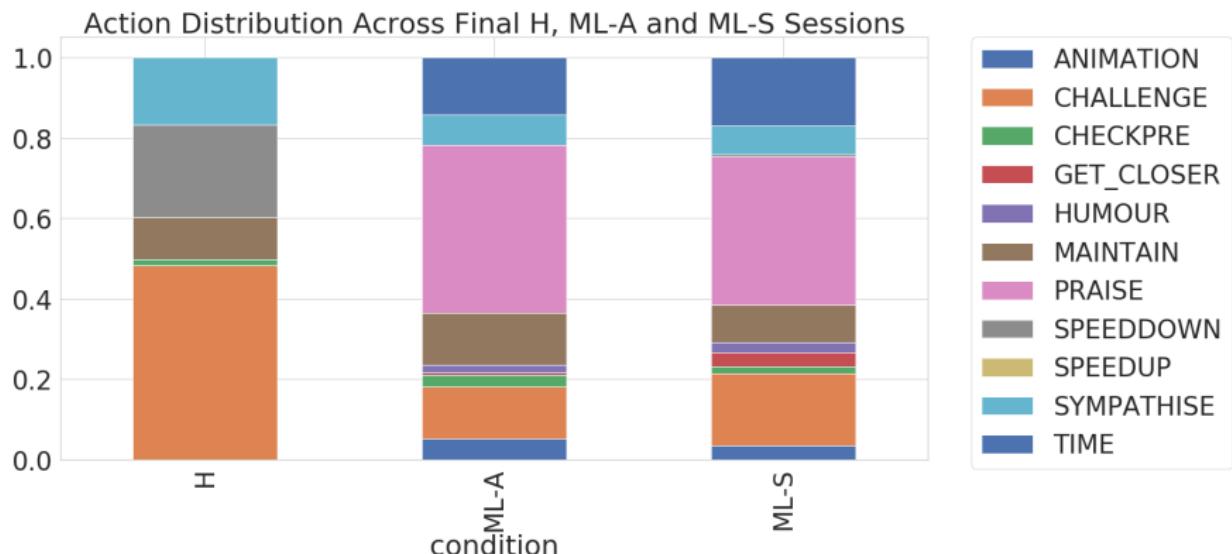


...TO DATA-DRIVEN HRI: INTERACTIVE  
REINFORCEMENT LEARNING









Who Am I?  
ooooo

Symbolic social cognition  
oooooooo

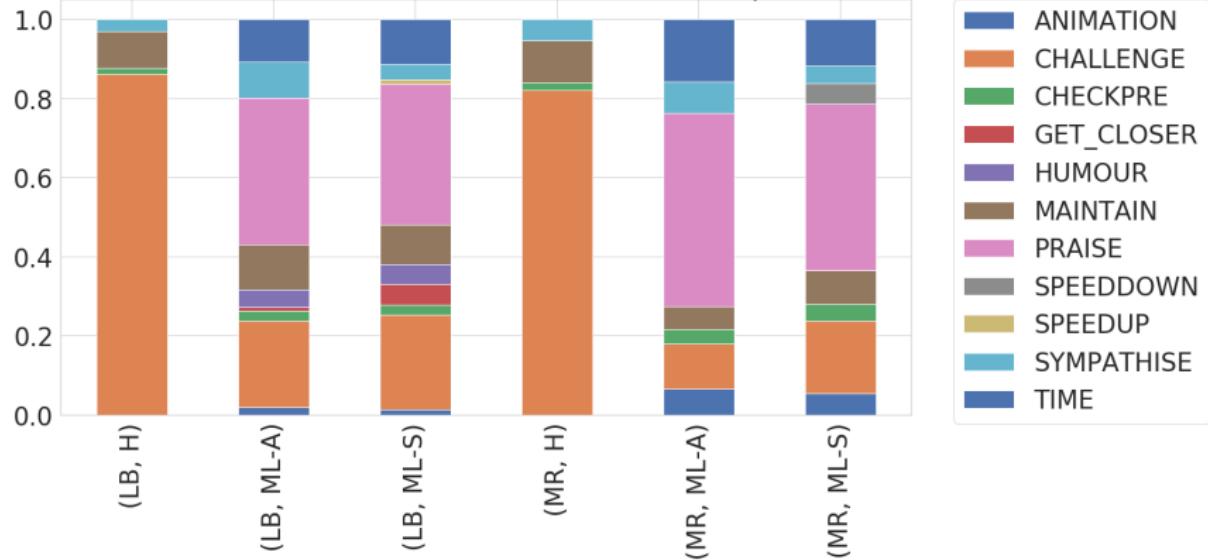
cHRI  
oo

Data-driven HRI  
ooooo●

Social dynamics  
ooooooo

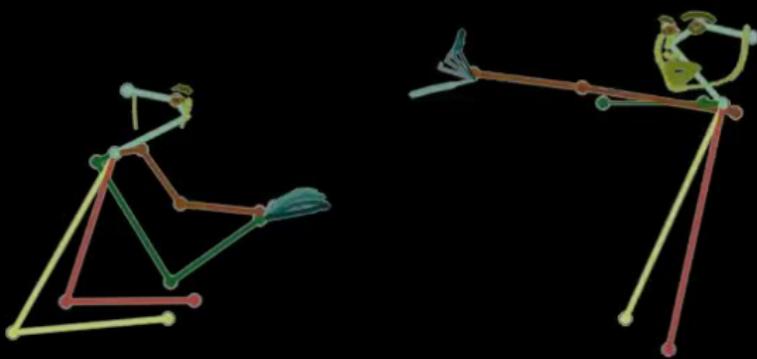
Where next?  
oooooooooooo

Phase 3 H, ML-A and ML-S Action Distribution for Participants LB and MR



# DATA-DRIVEN HRI: SOCIAL DYNAMICS









**Page 1 of 4.**

**How much do you agree with the following statements?**

The children were competing with one another.

Strongly Disagree

Disagree

Not Sure

Agree

Strongly Agree

200 participants, 4 clips each, on MTurk

The child on the left was sad.

Strongly Disagree

Disagree

Not Sure

Agree

Strongly Agree

# EFA: EXPLORATORY FACTOR ANALYSIS

	Factor 1 <i>full-scene</i>	Factor 2 <i>full-scene</i>	Factor 3 <i>full-scene</i>
△ Sad	0.41		
Σ Sad		0.72	
△ Happy	0.49		
Σ Happy			-0.55
△ Angry	0.40		
Σ Angry		0.81	
△ Excited	0.53		
Σ Excited			-0.71
△ Calm	0.45		
Σ Calm			
△ Friendly	0.69		
Σ Friendly			-0.43
△ Aggressive	0.78		
Σ Aggressive		0.80	-0.36
△ Engaged			0.65
Σ Engaged			-0.64
△ Distracted			0.65
Σ Distracted		0.63	
△ Bored			0.61
Σ Bored		0.58	0.48
△ Frustrated	0.53		
Σ Frustrated		0.70	
△ Dominant	0.75		
Σ Dominant		0.53	
△ Submissive	0.68		
Σ Submissive		0.54	

# EFA: EXPLORATORY FACTOR ANALYSIS

	Factor 1: imbalance <i>full-scene</i>	Factor 2: (negative) valence <i>full-scene</i>	Factor 3: engagement <i>full-scene</i>
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Σ Sad			0.72	0.53		0.49
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Σ Happy				-0.51		-0.55
△ Angry	0.40	0.62				
Σ Angry			0.81	0.85		
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△ Engaged		0.39				0.65
Σ Engaged						-0.64
△ Distracted						0.65
Σ Distracted			0.63			0.82
△ Bored		0.44				0.61
Σ Bored			0.58			0.48
△ Frustrated	0.53	0.61				
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# THREE CONSTRUCTS TO RULE THEM ALL

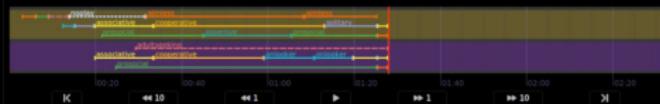


**Interaction imbalance**

**Interaction valence**

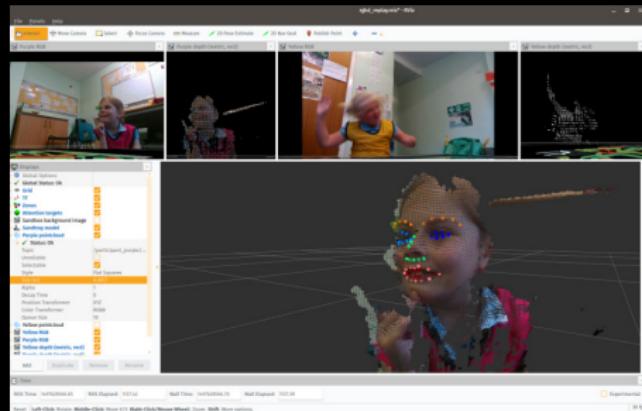
**Engagement**

WHERE NEXT?



01:28 (08.03.2015)

Auto-saving to /home/kslme/ignarfreesplay\_sandbox/data/2017-06-12\_143748652201/freesplay\_annotations.yaml



## How to push the state-of-the-art in social robotics?

- open, underspecified situations; rich semantics
- complex social dynamics
- diversity of tasks; long term, sustained interactions

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- responsible AI
  - *public-in-the-loop* research

## 'HUMAN-IN-THE-LOOP' HRI



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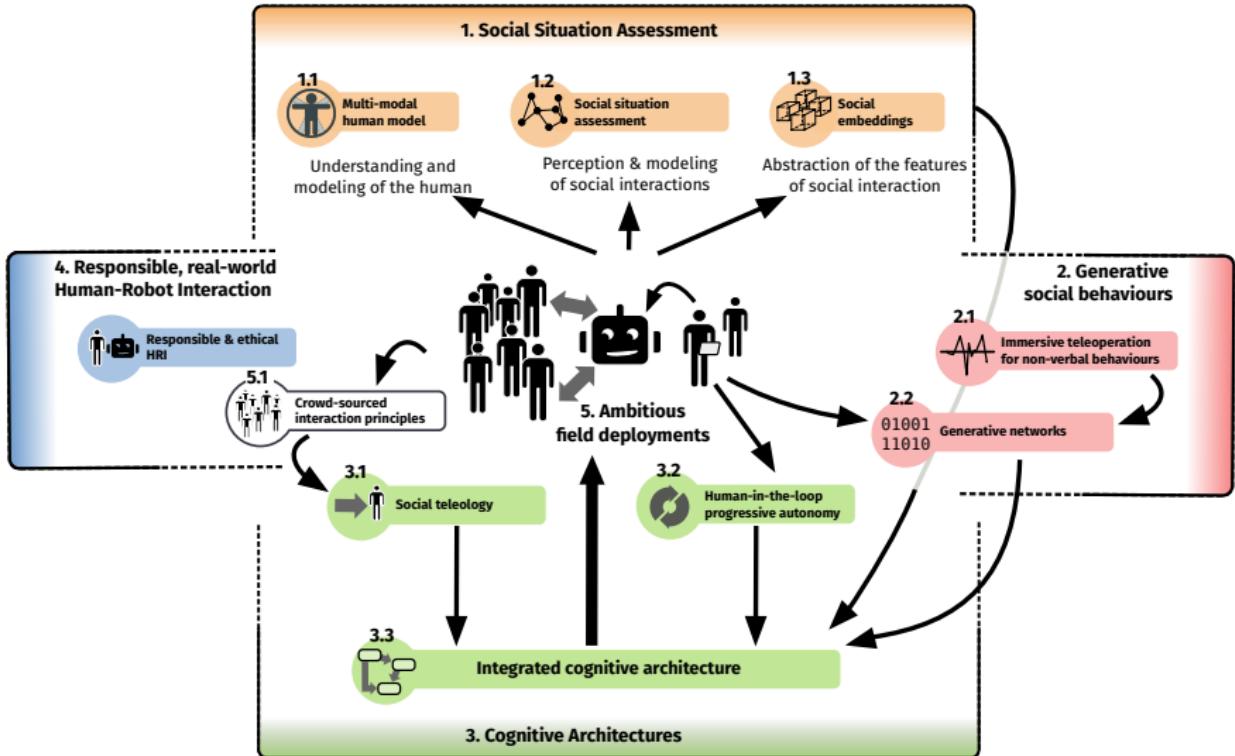


1. interactive reinforcement learning  
*how to scale it to multiple tasks?*  
*how to deal with non-trivial semantics?*
2. intrinsic social motivation  
*what meaningful & useful social goals?*
3. responsible AI  
*crowd-sourcing social norms for  
human-robot interactions*

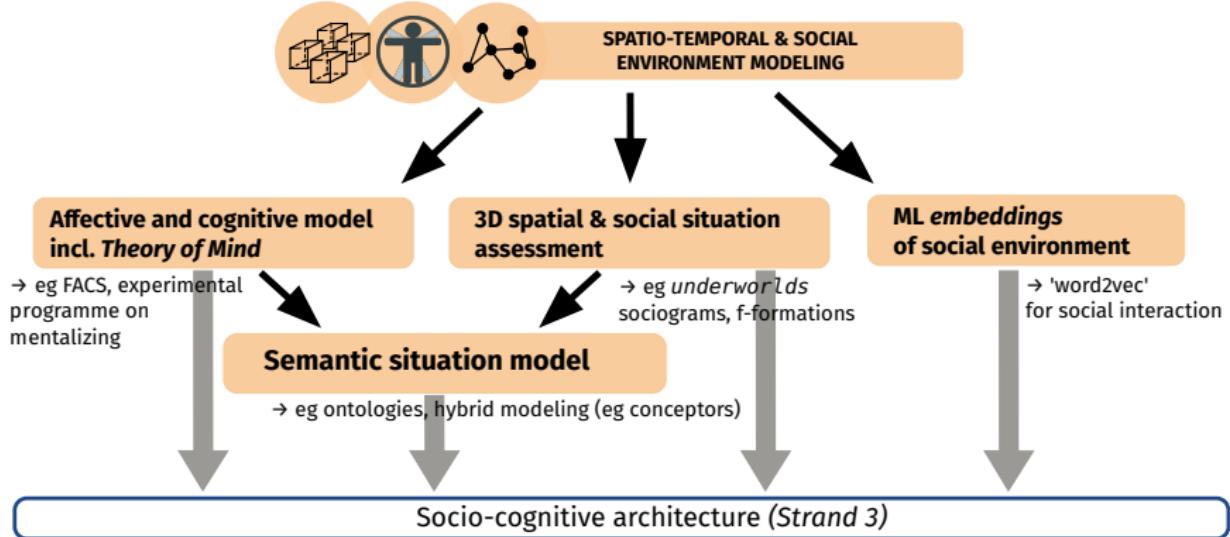
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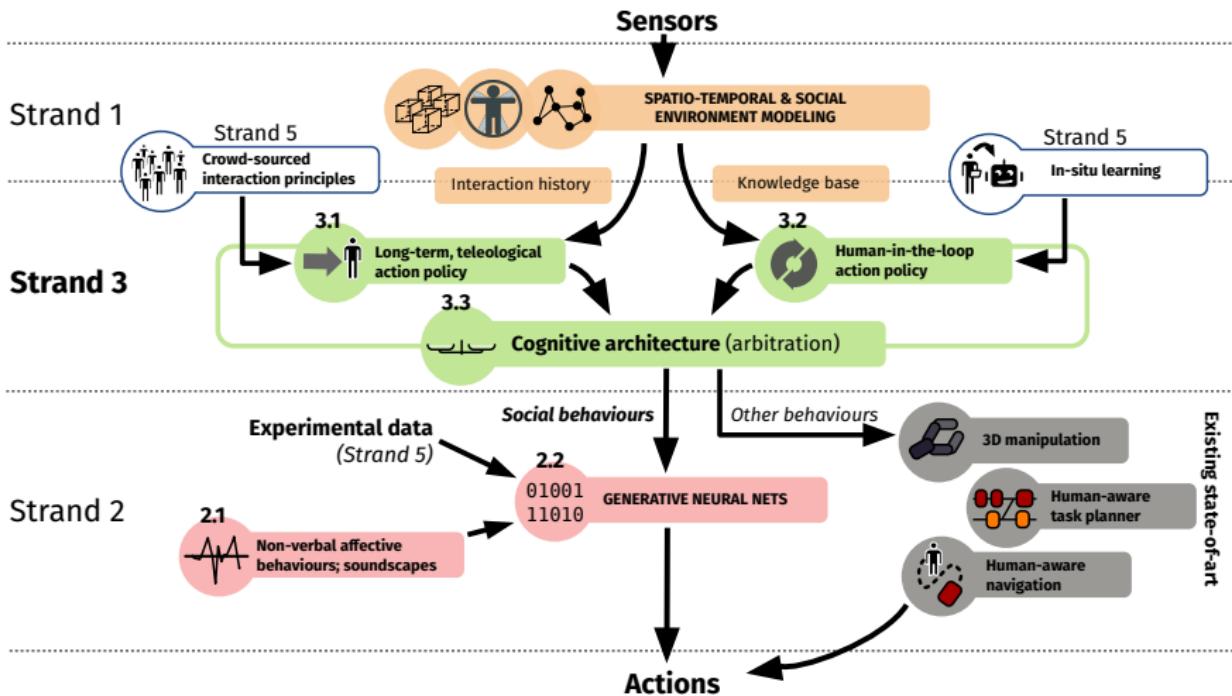


Shift from human-robot interactions to  
*robot-supported human-human  
interactions*









# INTEGRATION ISIR

→ natural integration to PiRos team

- work well aligned with Mohamed's on social signal processing

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Thank you!