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<https://github.com/severin-lemaignan/presentation-cognitive-robotics>

**WITH  
PLYMOUTH  
UNIVERSITY**



ÉCOLE POLYTECHNIQUE  
FÉDÉRALE DE LAUSANNE



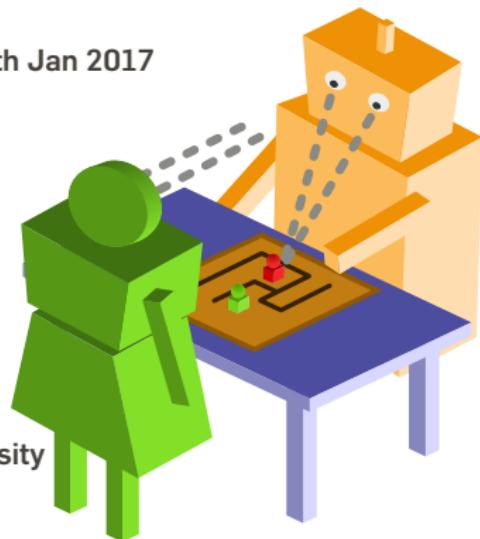
# robots in the classroom

## to be or not to be social?

Cognovo Symposium: Group Creativity and Education – **26th Jan 2017**

Séverin Lemaignan

Centre for Robotics and Neural Systems **Plymouth University**  
**CHILI Lab EPFL**





## SOCIAL OR NOT SOCIAL?



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## NON-SOCIAL INTERACTION

What is the most effective learning tool in a classroom?

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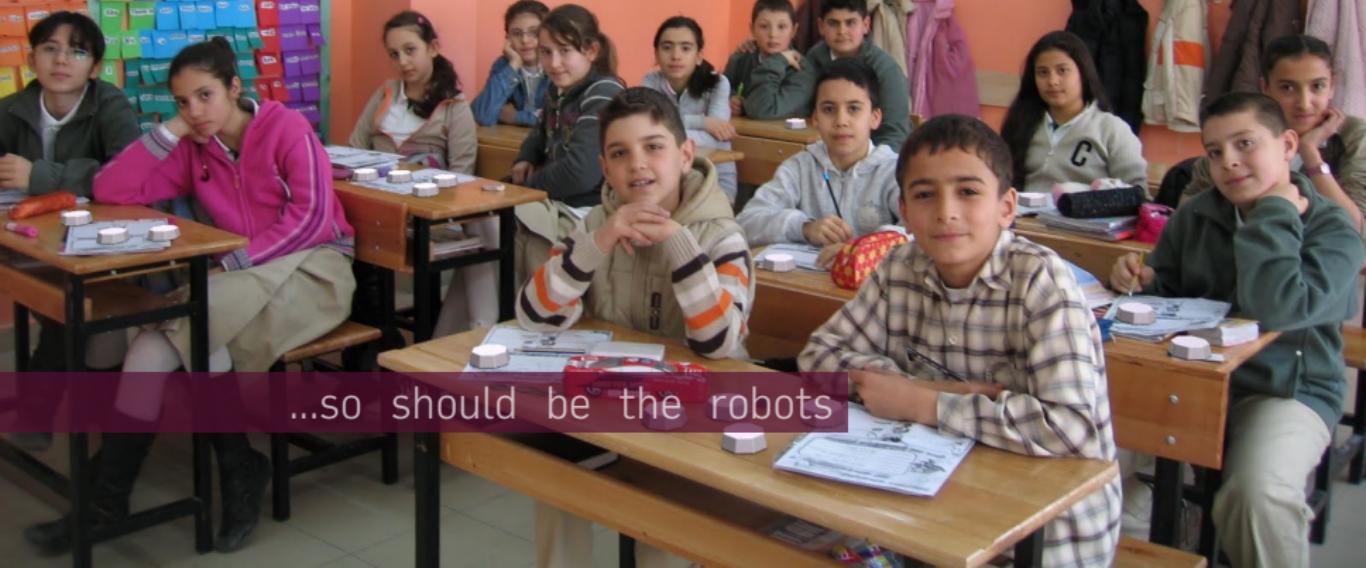




Pens and paper are pervasive...



WORDMANIA



...so should be the robots

## CELLULO: DESIGN PRINCIPLES

- **ubiquitous:** a pervasive yet unremarkable tool that blend into the daily learning routine; has to be reliable (i.e. trustworthy), readily replaceable (i.e. cheap, no affective bonding), intuitive (i.e. few simple affordances)

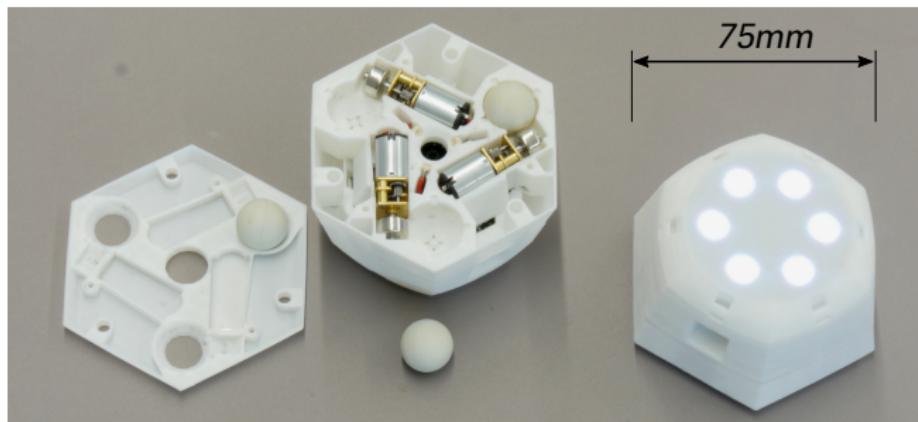
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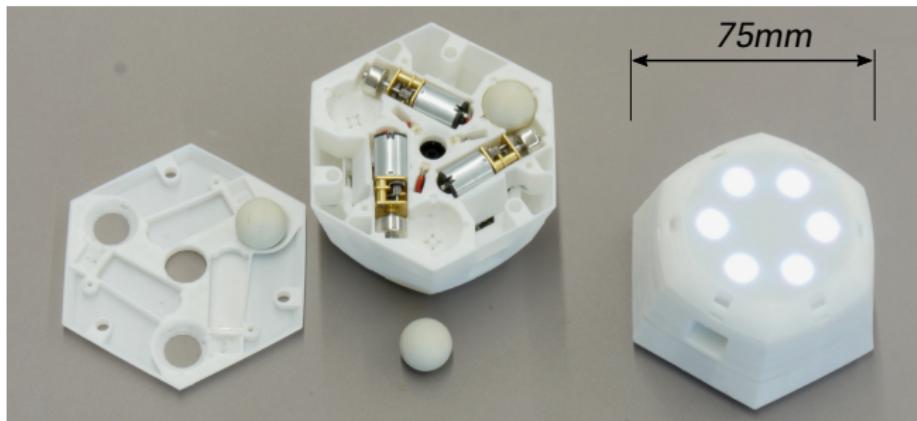
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- **versatile:** applicable to a broad range of learning scenarios; the robots' hardware, appearance and interaction modalities must not imply or be constrained to specific use cases
- **practical:** to gain field acceptance in the classrooms, educative robots must critically represent a net educative gain and must not incur higher workload for the teachers

## HOW DOES IT LOOK LIKE?



- Omnidirectional
- Haptic feedback + tactile RGB LED buttons
- Bluetooth
- Accurate self-localisation

## HOW DOES IT LOOK LIKE?



- Omnidirectional
- Haptic feedback + tactile RGB LED buttons
- Bluetooth
- Accurate self-localisation
- Affordable (prototype: £100)



## INTERACTION WITH THE PAPER

Critically, Cellulo is meant as an **interaction between the (classroom-friendly) paper and the robots.**

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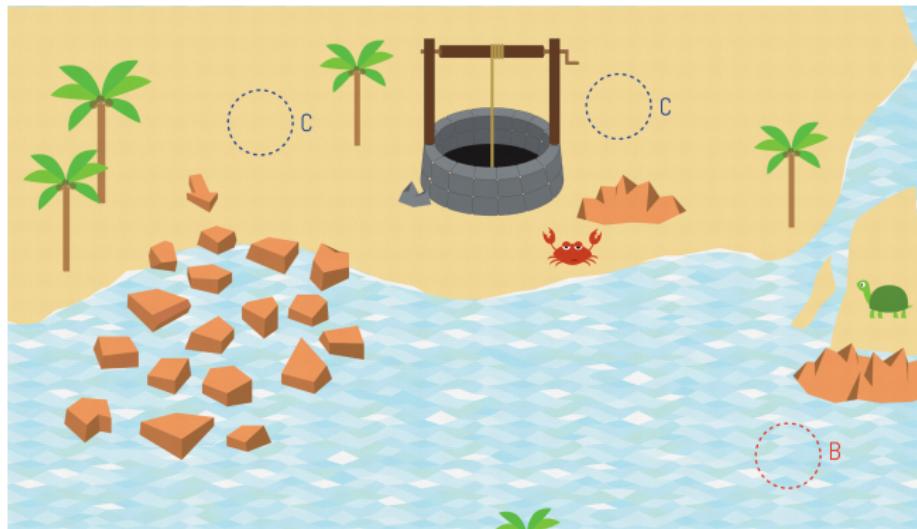
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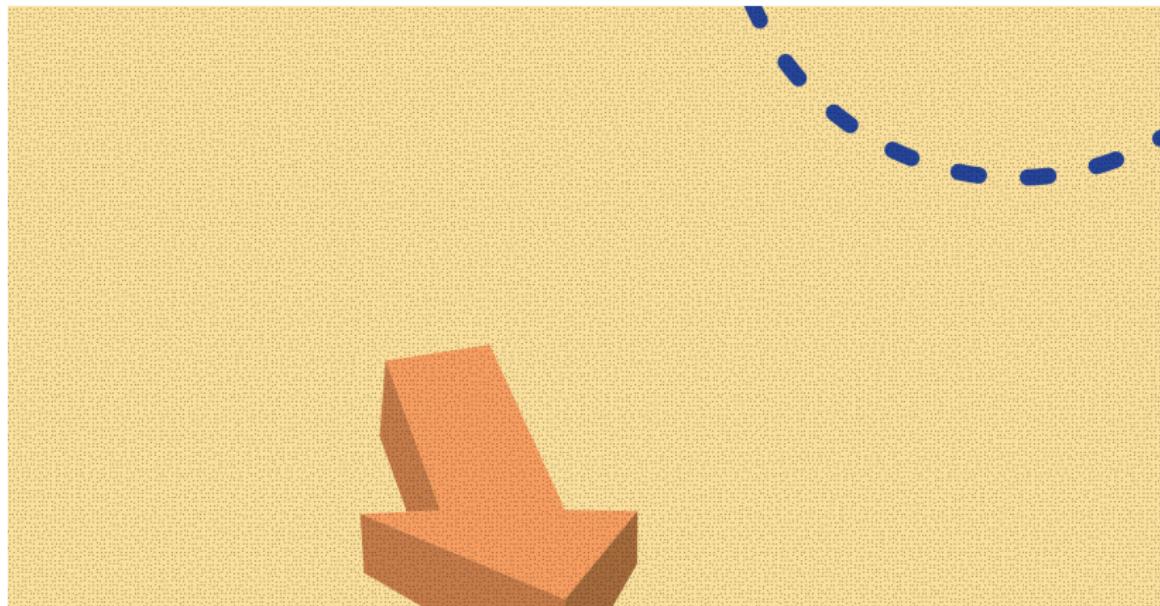
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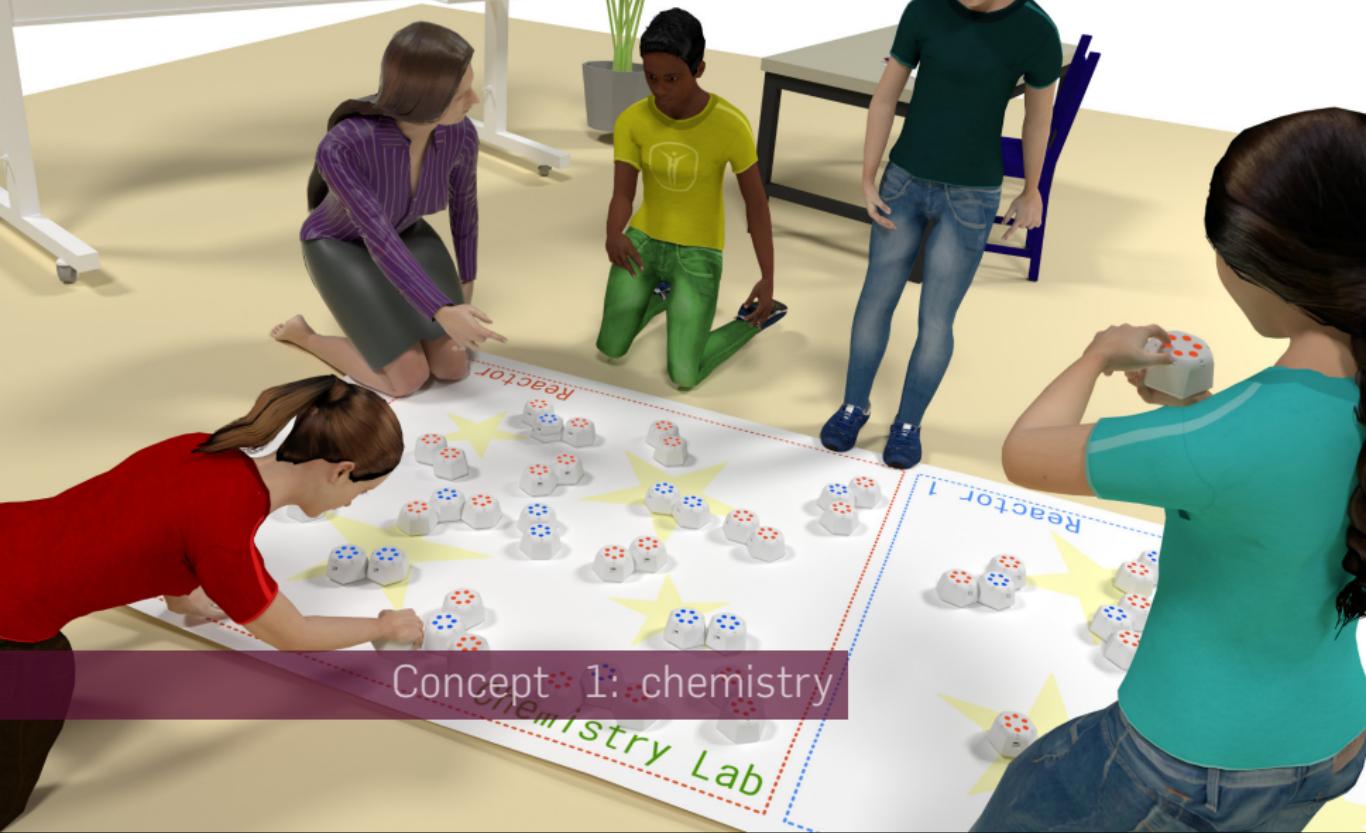
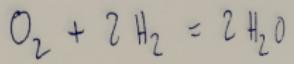


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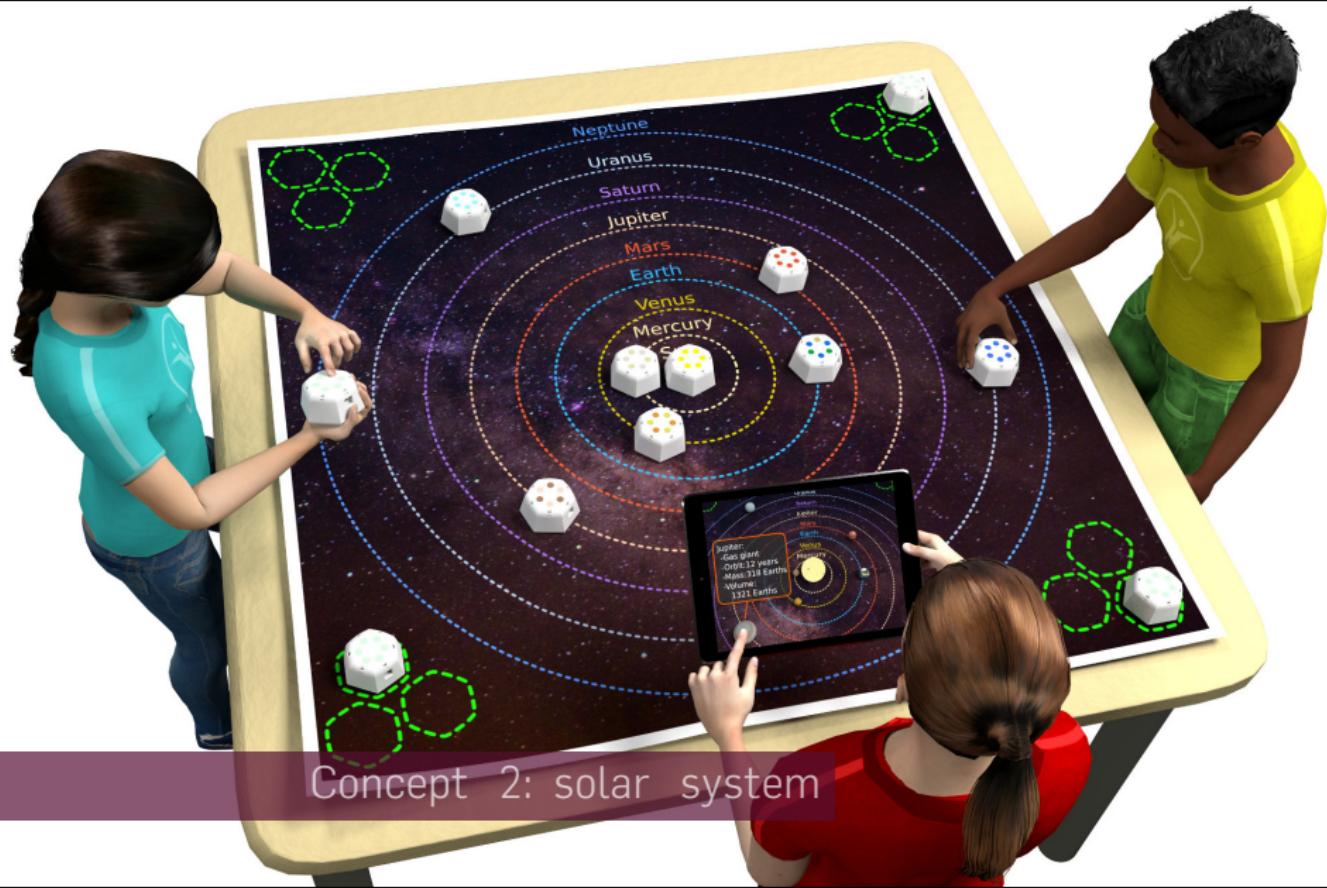
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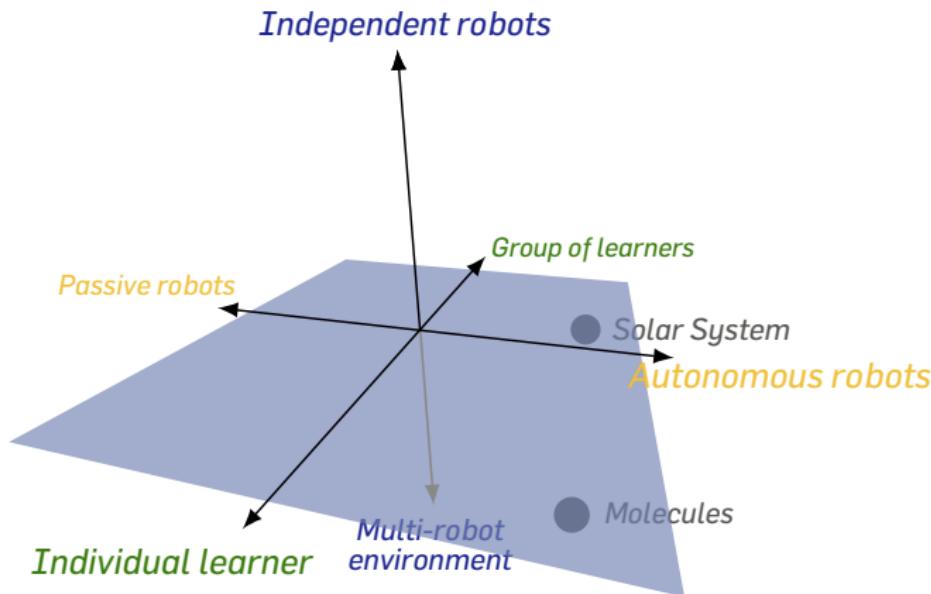
- even more than 'classroom-friendly', paper is 'teacher-friendly'
- easy to manipulate, copy, print, cutout, dispose...
- unique activity IDs: drop the robots onto the sheet, it recognizes the activity



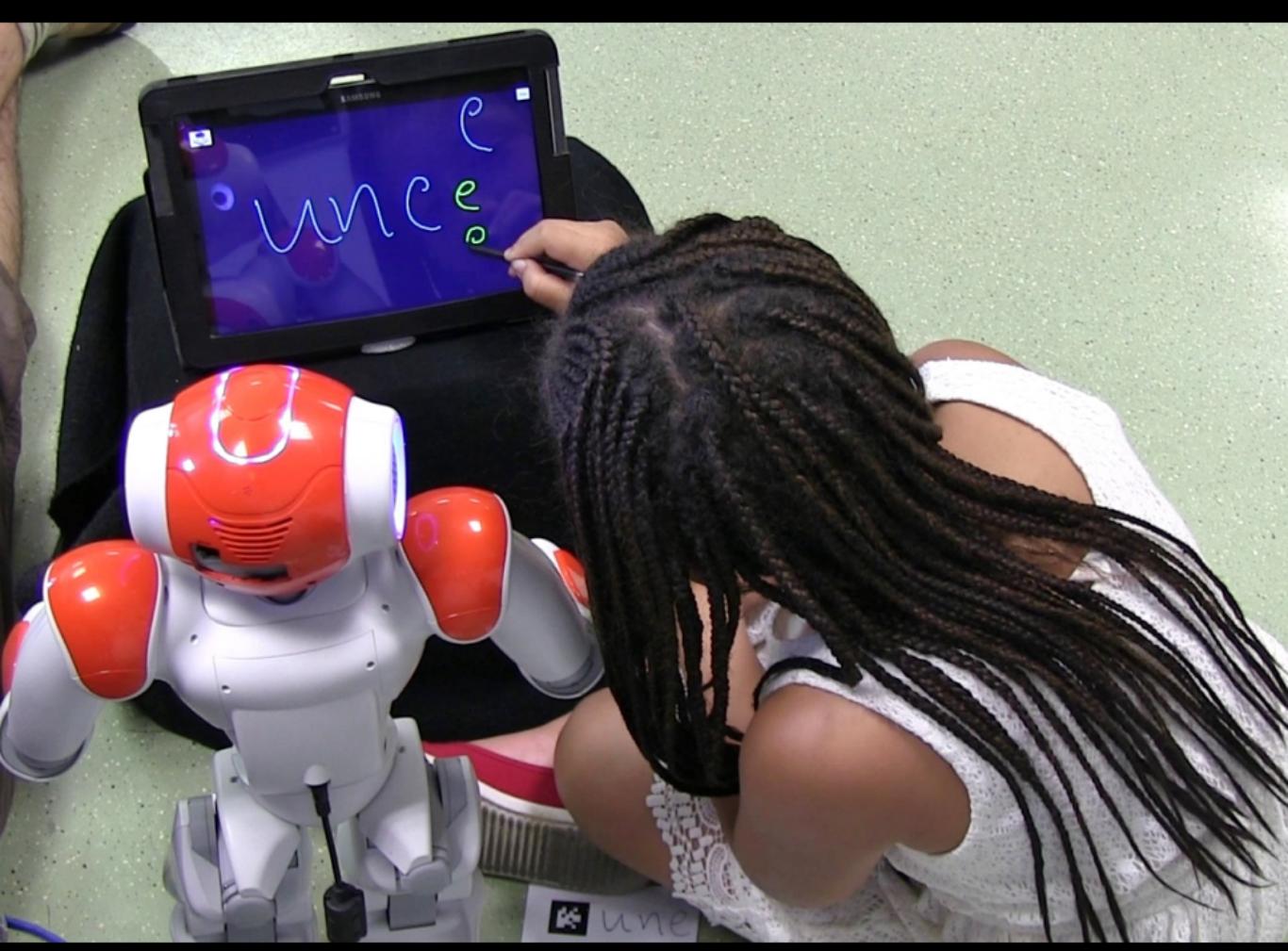
## Concept 2: solar system

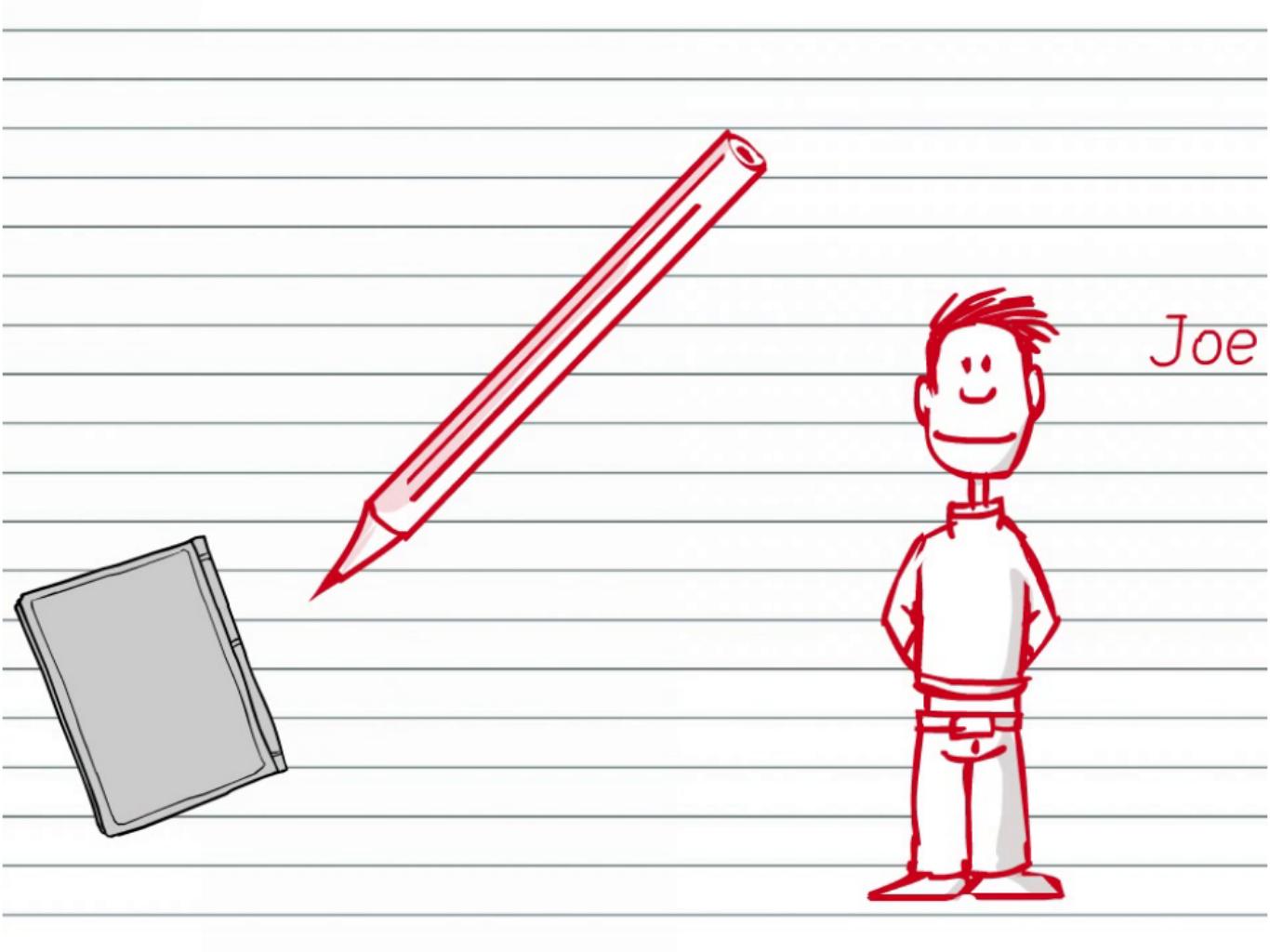


# INTERACTION DESIGN SPACE



...at the other end of the spectrum...





Joe

I'm not  
good at this

what's  
the use?

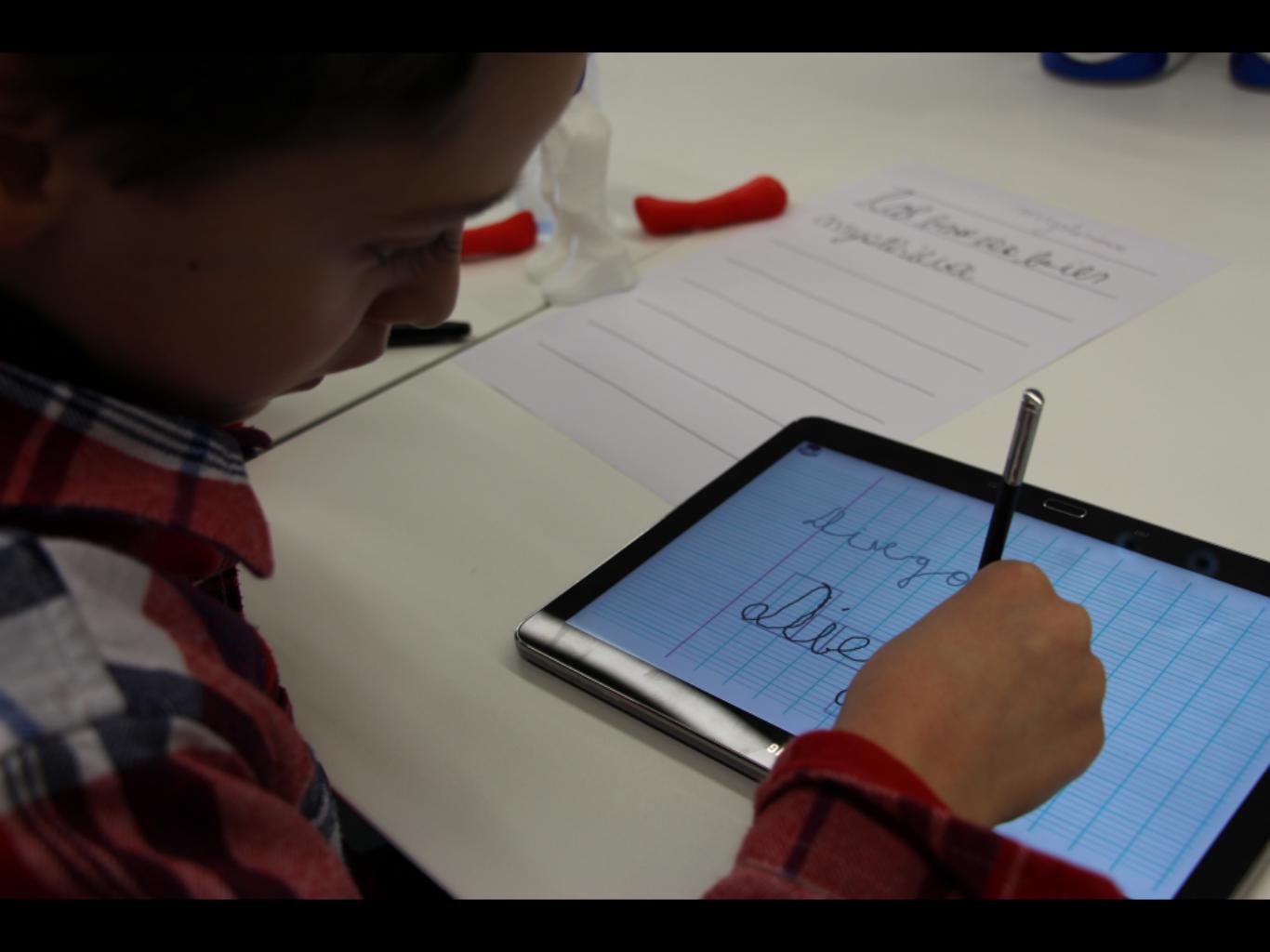
... but, everyone  
can see



Lithuanian  
mythica

Diego

Allie



## ROBOTS?

- Robots do not know how to write!

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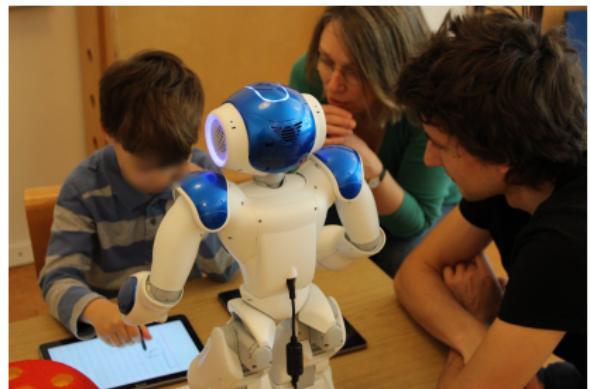
- Robots do not know how to write!
- Learning by teaching
- (nice side-effect: we can adapt to each child and each disabilities)



Mind modelling is **mutual**

We can take advantage of it in human-robot interaction at  
fundamental levels

# COGNITIVE ENGAGEMENT AND META-COGNITION



## LEARNING FROM DEMONSTRATION



## BEFORE – AFTER

salut mimi  
nous pensons  
que c'est un  
corps  
est ce que tu penses  
croire des  
photos de  
la buse

## BEFORE – AFTER

salut mimi  
nous pensons  
que c'est un  
corps  
est ce que tu peux  
croire des  
photos de  
la base

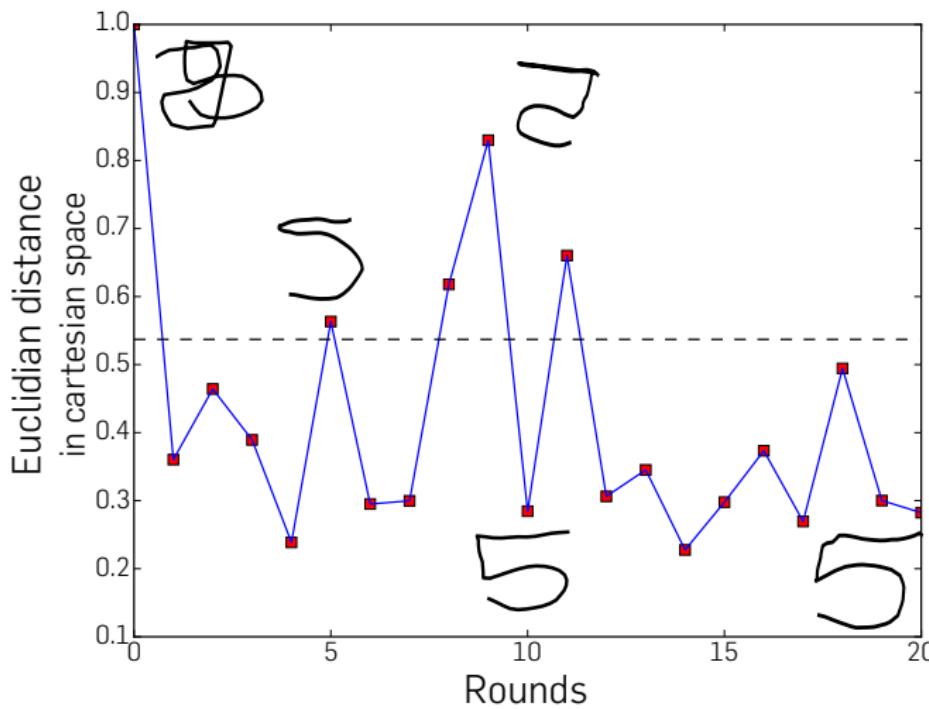
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# LEARNING TO DRAW A 5



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- **The robot as a cognitive agent is key here**
  - Protégé effect
  - metacognition

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  - Protégé effect
  - metacognition
- **New role:** not a 'tool to teach robotics', not a facilitator
  - (note: a tool for the teacher vs a social agent for the child!)
  - Could we replace it by someone else? Not easily

A group of children are playing in a classroom. In the foreground, a young boy wearing blue plastic glasses is smiling and looking up. Behind him, another child is kneeling on the floor, and further back, several other children are playing with toys. A white wooden cabinet with large blue plastic glasses on it is visible. On the left, a girl in a blue floral dress stands with her hands on her hips. The room has white walls and various educational materials.

So? Social or not social?

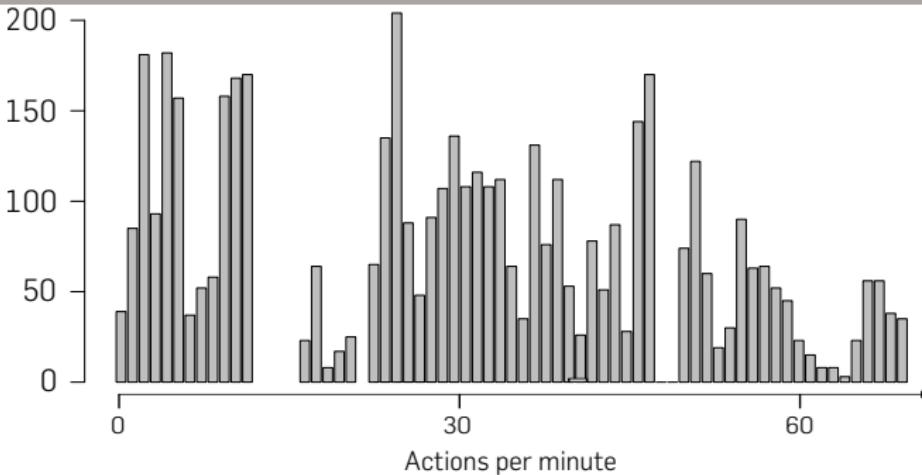
**Thank you!**

Séverin Lemaignan

Portland Square A216 – [severin.lemaignan@plymouth.ac.uk](mailto:severin.lemaignan@plymouth.ac.uk)

# CHILD-ROBOT INTERACTION ON THE PRACTICAL SIDE





lightbar  
 on\_toy\_added  
 move  
 background\_blink  
 undock  
 pulse\_row  
 blink  
 on\_lolette  
 placeeyes

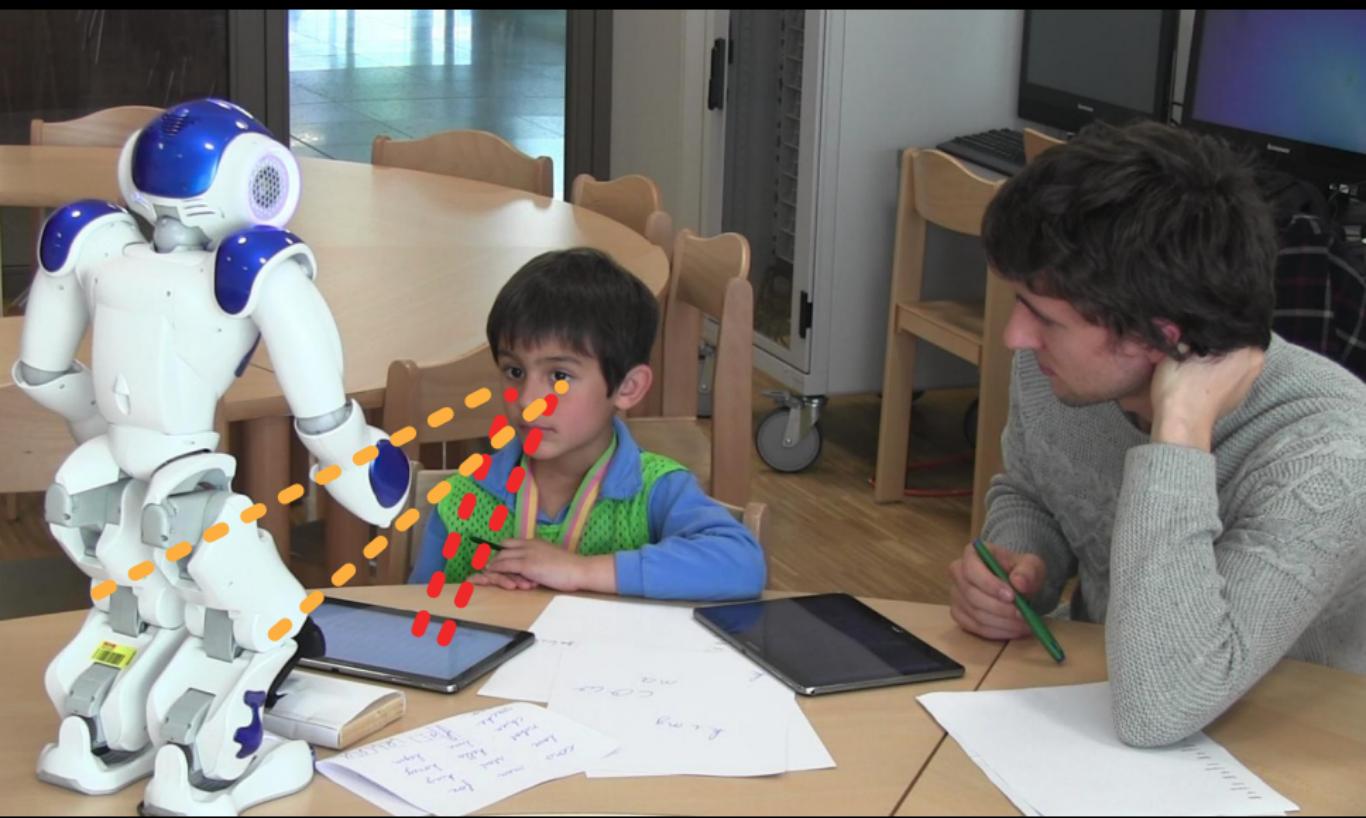
on\_bumped  
 up\_down\_row  
 wakeup  
 look\_at\_caresses  
 on\_toy\_removed  
 sneak\_in  
 on\_lolette\_removed  
 fall\_asleep  
 look\_at\_lolette

active\_wait  
 closeeyes  
 lightpattern  
 turn  
 idle  
 playsound  
 blush

Can we make the analysis of child-robot interaction **practical**?

- (surface) engagement
- cognitive perception/anthropomorphism
- child speech recognition

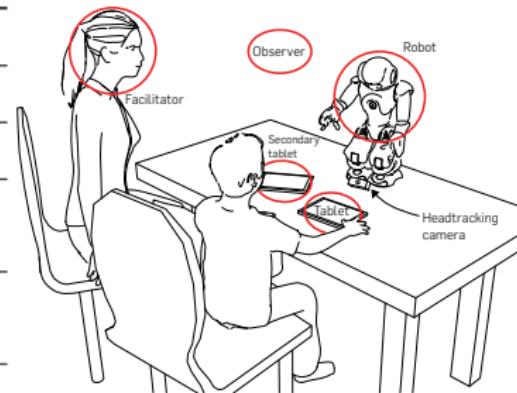


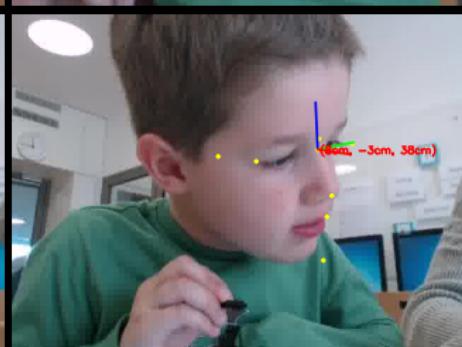
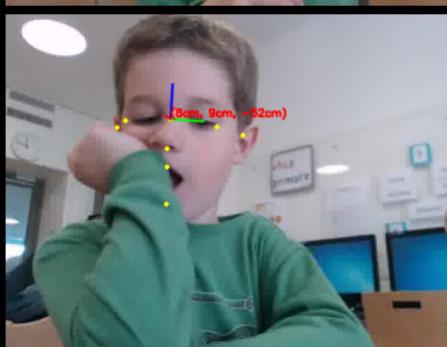
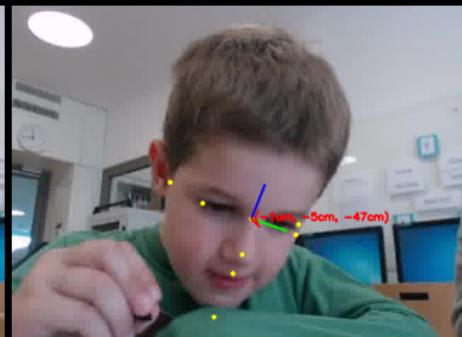
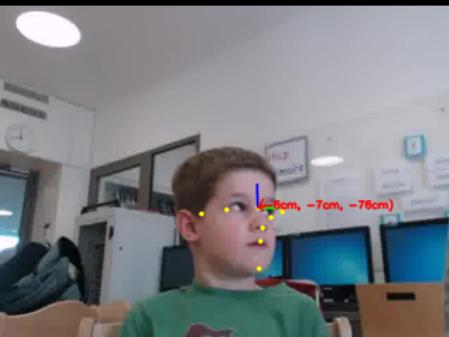


## EXPECTED FOCUS

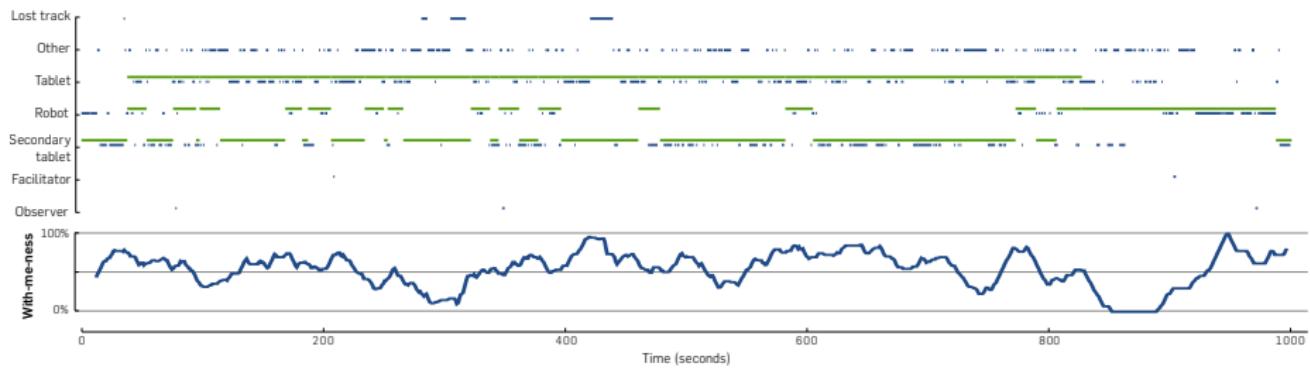
Example for the CoWriter task:

Interaction Phase	Expected targets
Presentation	robot
Waiting for word	secondary tablet
Writing word	tablet robot
Waiting for feedback	tablet secondary tablet
Story telling	robot
Bye	robot





# WITH-ME-NESS



## WITH-ME-NESS IS...

### With-me-ness is...

- An **objective** & **quantitative** precursor of engagement...
- ...based on matching the **user's focus of attention** with a set of **prior expectations**
- Can be computed **on-line** by the robot...
- ...and **sensitive to** the (task-dependent) **set of expectations**
- ⇒ **relative** metric!



# CONSTRUCTS FOR COGNITIVE PERCEPTION ANALYSIS

## Expectations

*How do you imagine a robot?  
What could it look like?  
Have you ever seen a robot before?*

## Impression

*When you first saw R, what did you think?  
Is R a robot? How do you know?  
Did you expect R would come over to you when you call it?  
What happened when you put the domino in the box?*

## Ascribe intention

*Do you think R could go out the door all by itself?  
Does R always obey / come over to you?  
Could R do something silly?  
Why did R not come over to you when you called it?*

## Ascribe perceptual capabilities

*Here is a domino. Do you think R can see it?  
When I say "Hello R!", do you think R can hear it?*

## Ascribe emotional state

*Does R have feelings? Can R be happy or sad sometimes?*

## Social acceptance

*Do you like R? Why (not)?  
What do you (not) like about it?  
Would you like to have R at home?*

## Companionship

*Could R be your friend? Why (not)?*

## Ascribe moral standing

*Assume you go on a holiday for two weeks. Is it alright to leave R alone at home? Why (not)?*

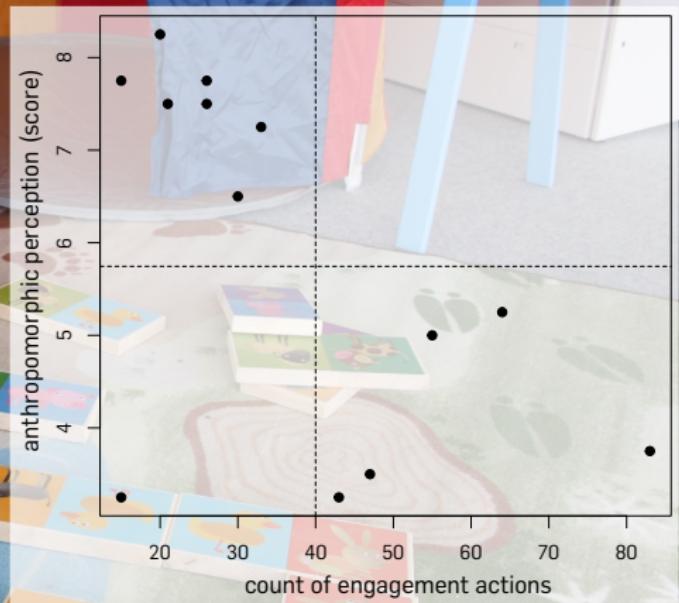
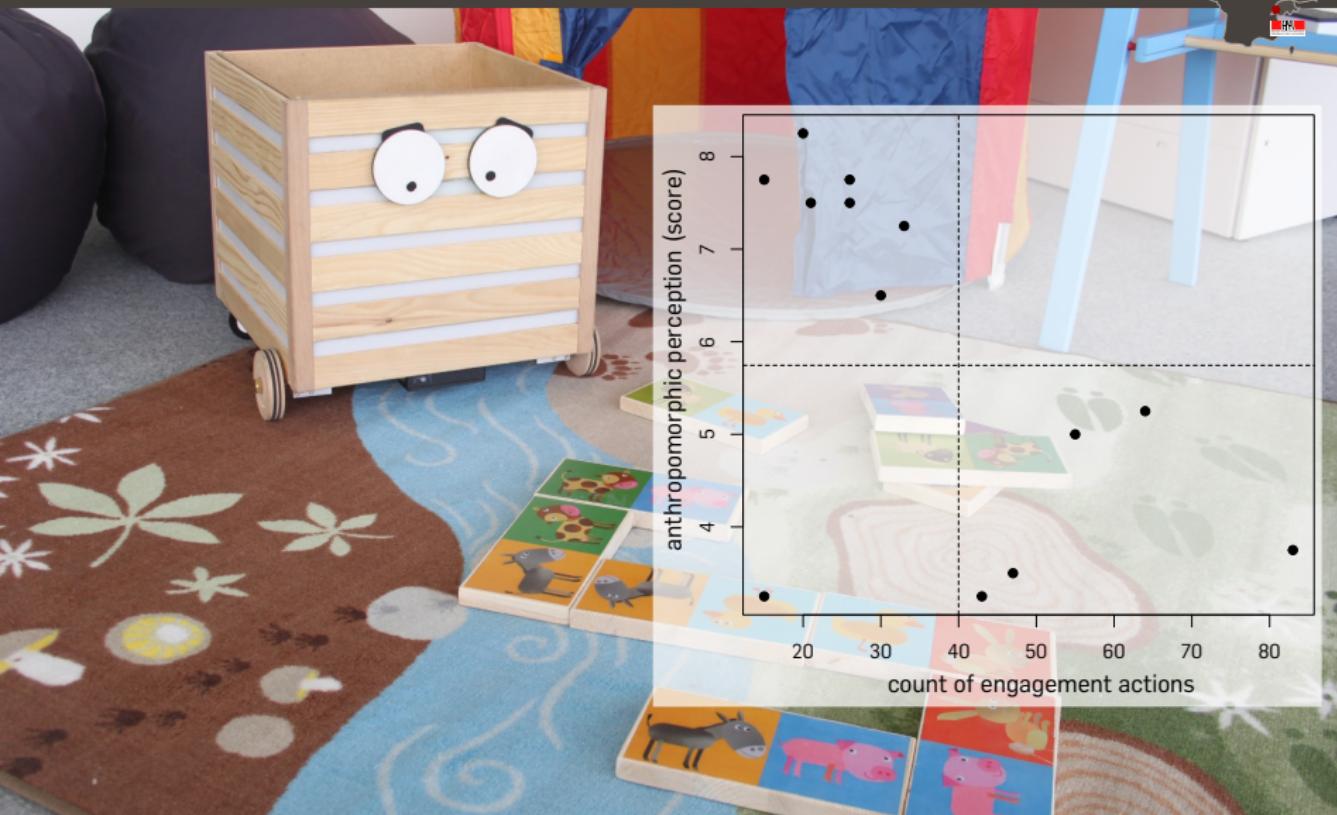
# BEHAVIOUR VS PERCEPTION?

Any relation between the behavioural and perceptual measurements?



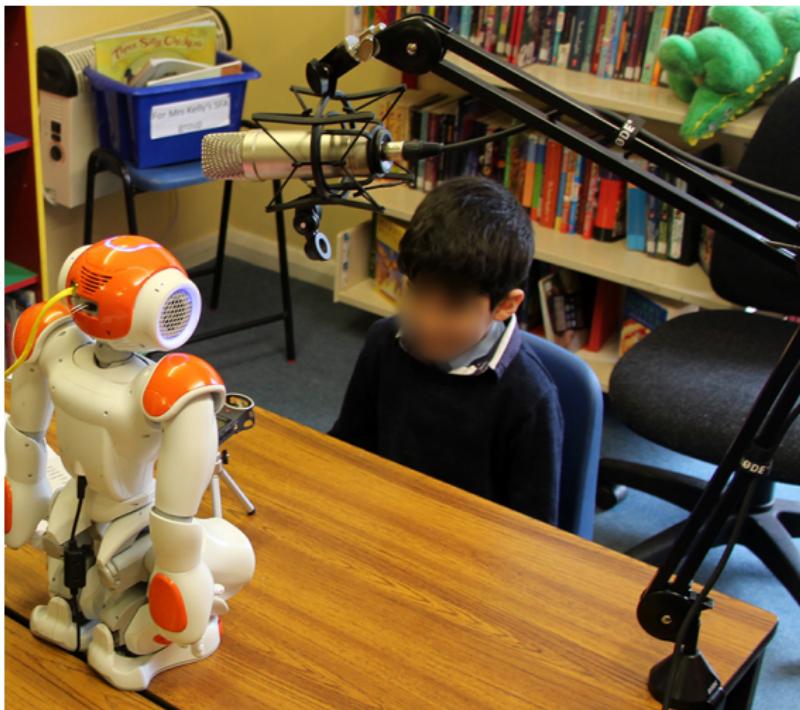
We can compute for each pair an "anthropomorphic perception" score based on the cognitive ascriptions, and...

# ANTHROPOMORPHISM != ENGAGEMENT





# AUTOMATIC SPEECH RECOGNITION WITH CHILDREN



## AUTOMATIC SPEECH RECOGNITION WITH CHILDREN



	Google		Bing		Sphinx		Nuance		
	M	LD	% rec.	M	LD	% rec.	M	LD	% rec.
<b>fixed</b> (n=34)	<b>0.34</b>		<i>11.8 [38]</i>	0.64	<i>0 [0]</i>	0.68	<i>0 [0]</i>	0.76	<i>0 [0]</i>
<b>spontaneous</b> (n=222)	<b>0.39</b>		<i>6.8 [17.6]</i>	0.64	<i>0.5 [2.4]</i>	0.80	<i>0 [0]</i>	0.80	<i>0 [0]</i>
<b>spontaneous</b> clean only (n=83)	<b>0.40</b>		<i>6.0 [16.9]</i>	0.63	<i>1.2 [1.2]</i>	0.78	<i>0 [0]</i>	0.78	<i>0 [0]</i>

**M LD:** mean Levenshtein distance, at word level.