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

WITH PLYMOUTH UNIVERSITY

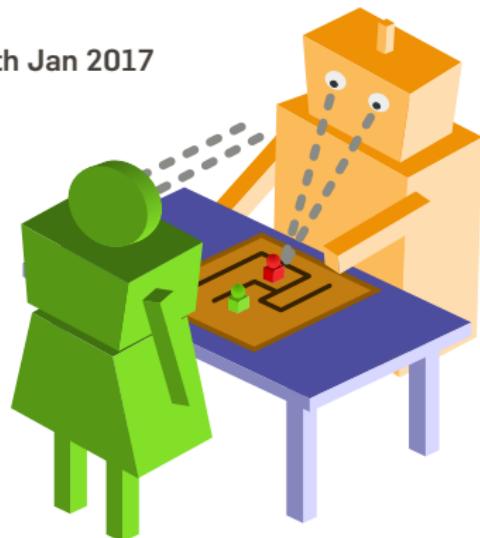


robots in the classroom to be or not to be social?

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

Séverin Lemaignan

Centre for Robotics and Neural Systems
Plymouth University





SOCIAL OR NOT SOCIAL?



SOCIAL OR NOT SOCIAL?



NON-SOCIAL INTERACTION

What is the most effective learning tool in a classroom?

NON-SOCIAL INTERACTION

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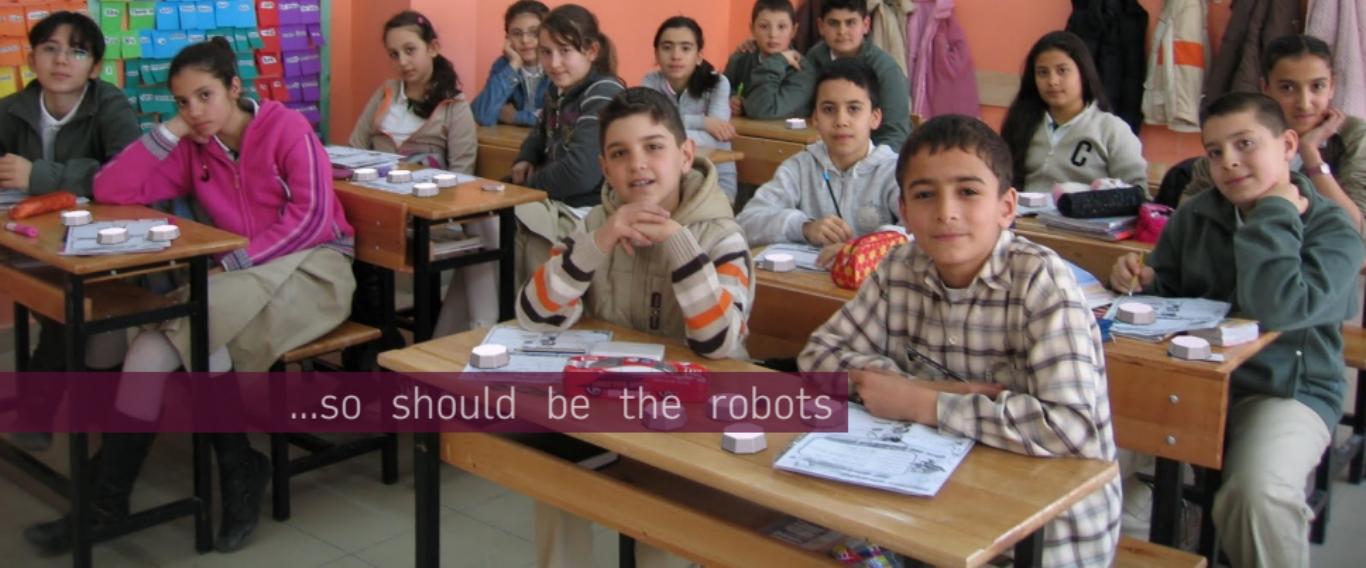




Pens and paper are pervasive...



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)

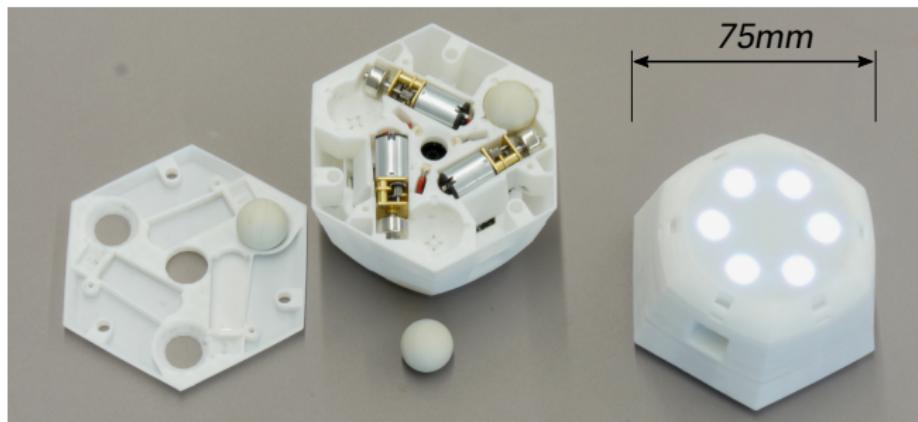
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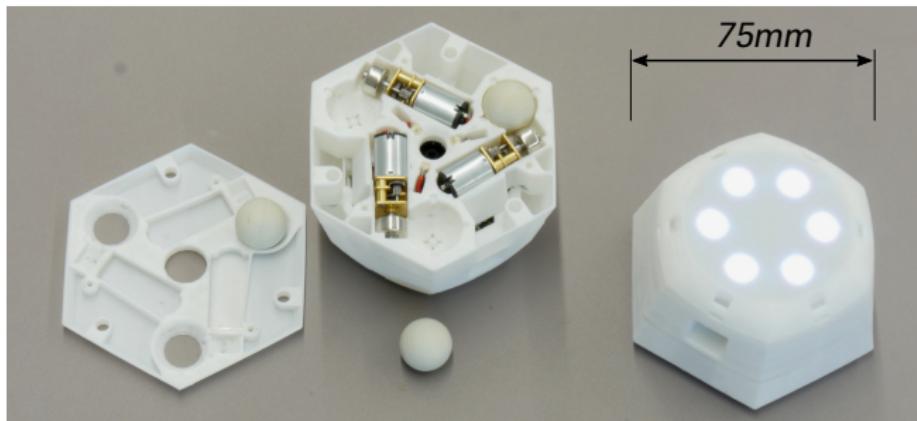
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- **versatile:** applicable to a broad range of learning scenarios; the robots' hardware, appearance and interaction modalities must not imply or be constrained to specific use cases
- **practical:** to gain field acceptance in the classrooms, educative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

INTERACTION WITH THE PAPER

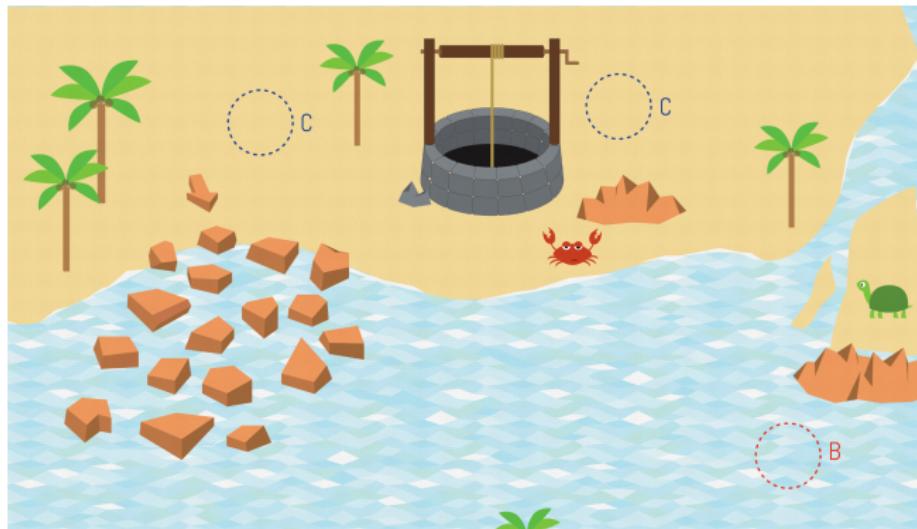
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Achieved through a **paper-based self-localisation system**

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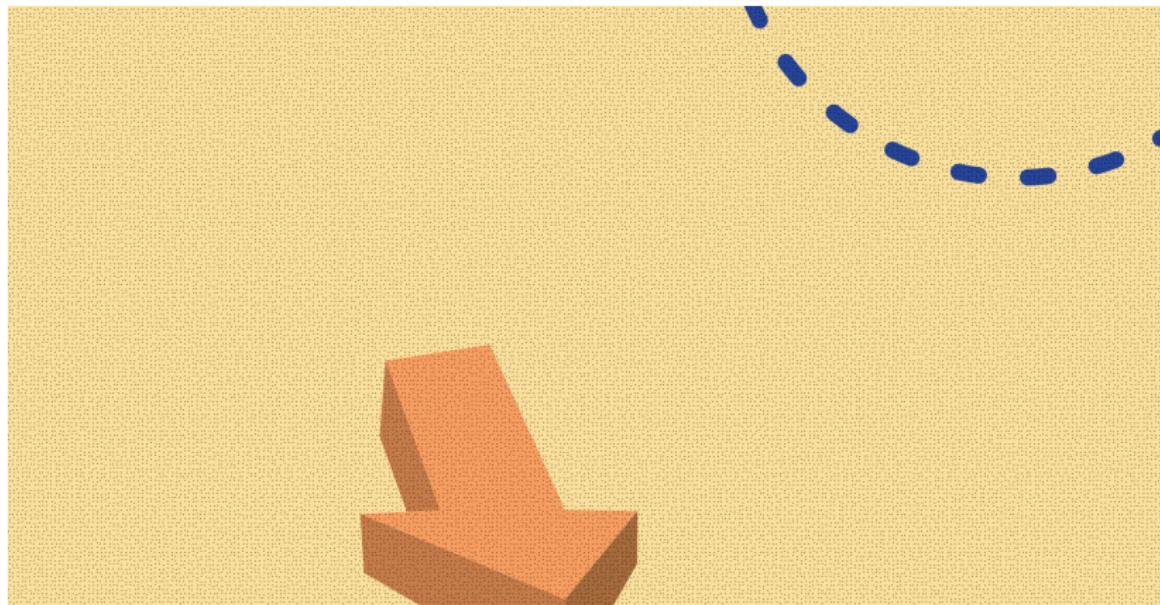
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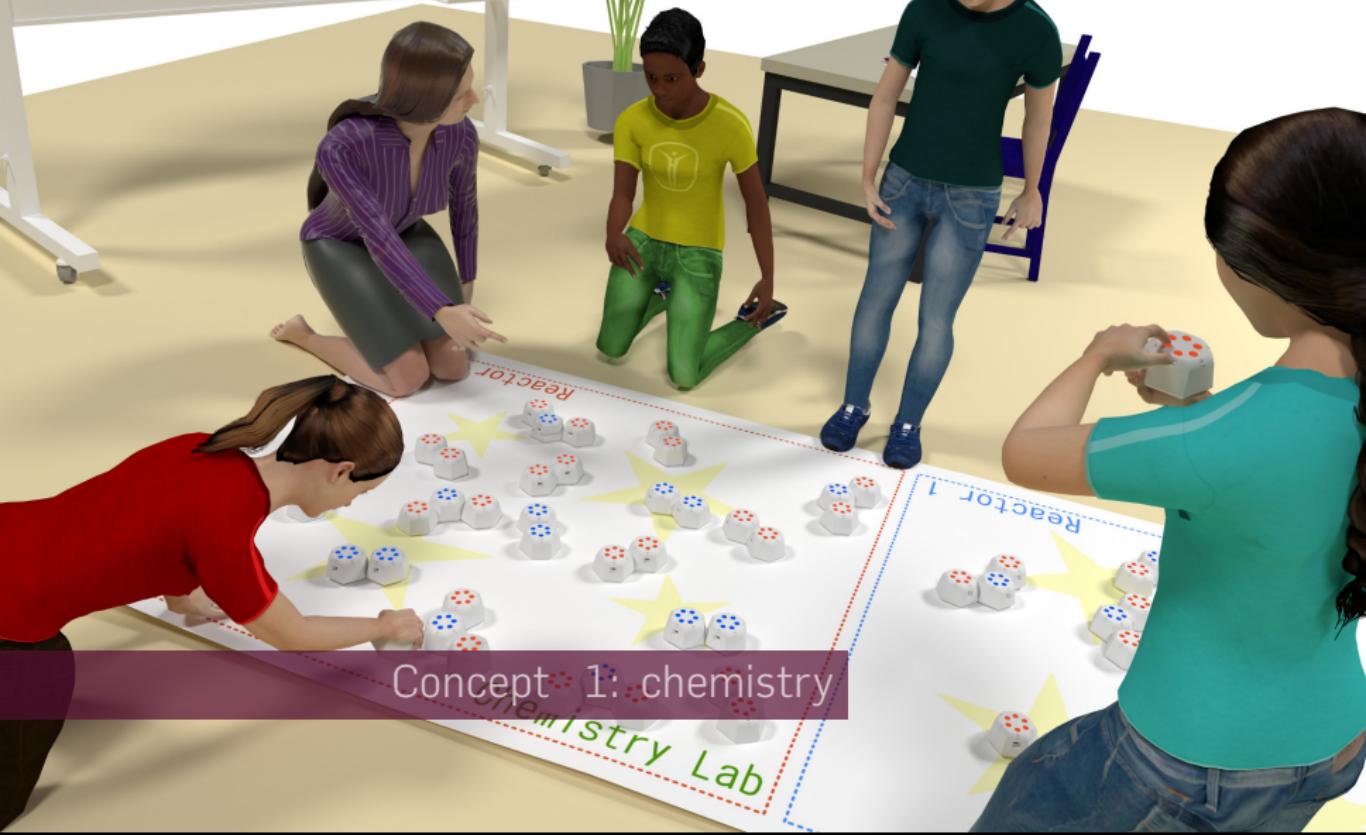
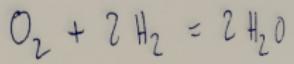


INTERACTION WITH THE PAPER

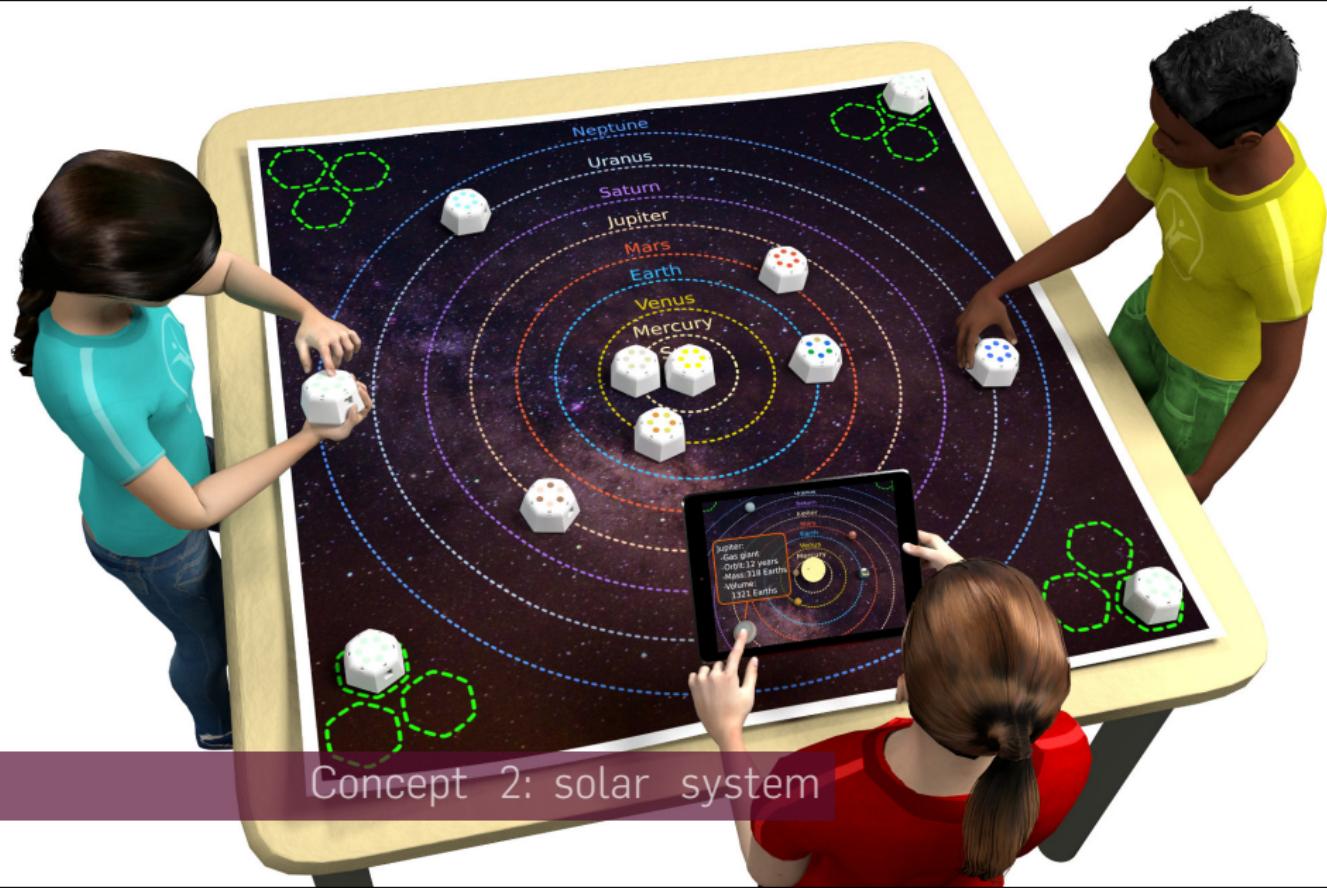
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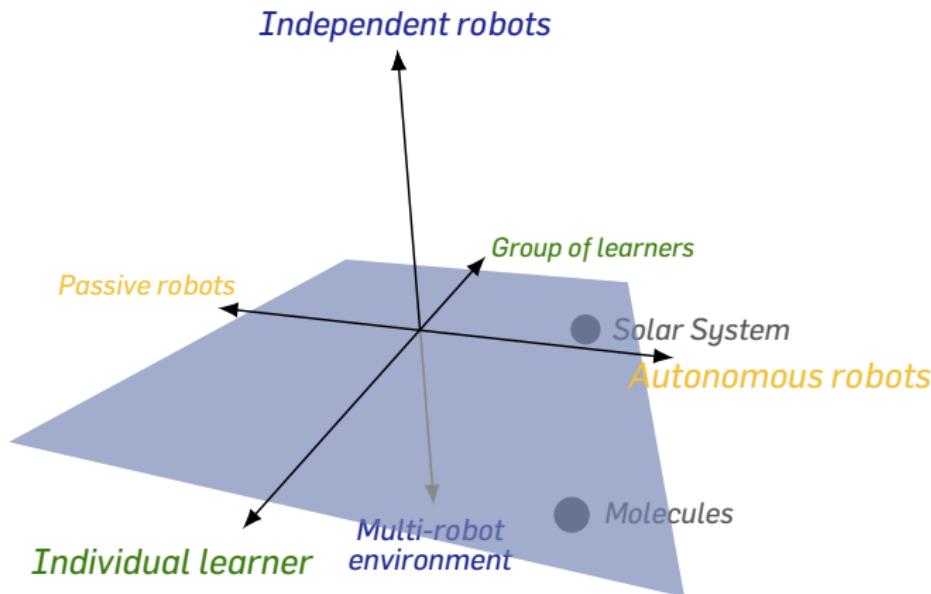
- even more than 'classroom-friendly', paper is 'teacher-friendly'
- easy to manipulate, copy, print, cutout, dispose...
- unique activity IDs: drop the robots onto the sheet, it recognizes the activity



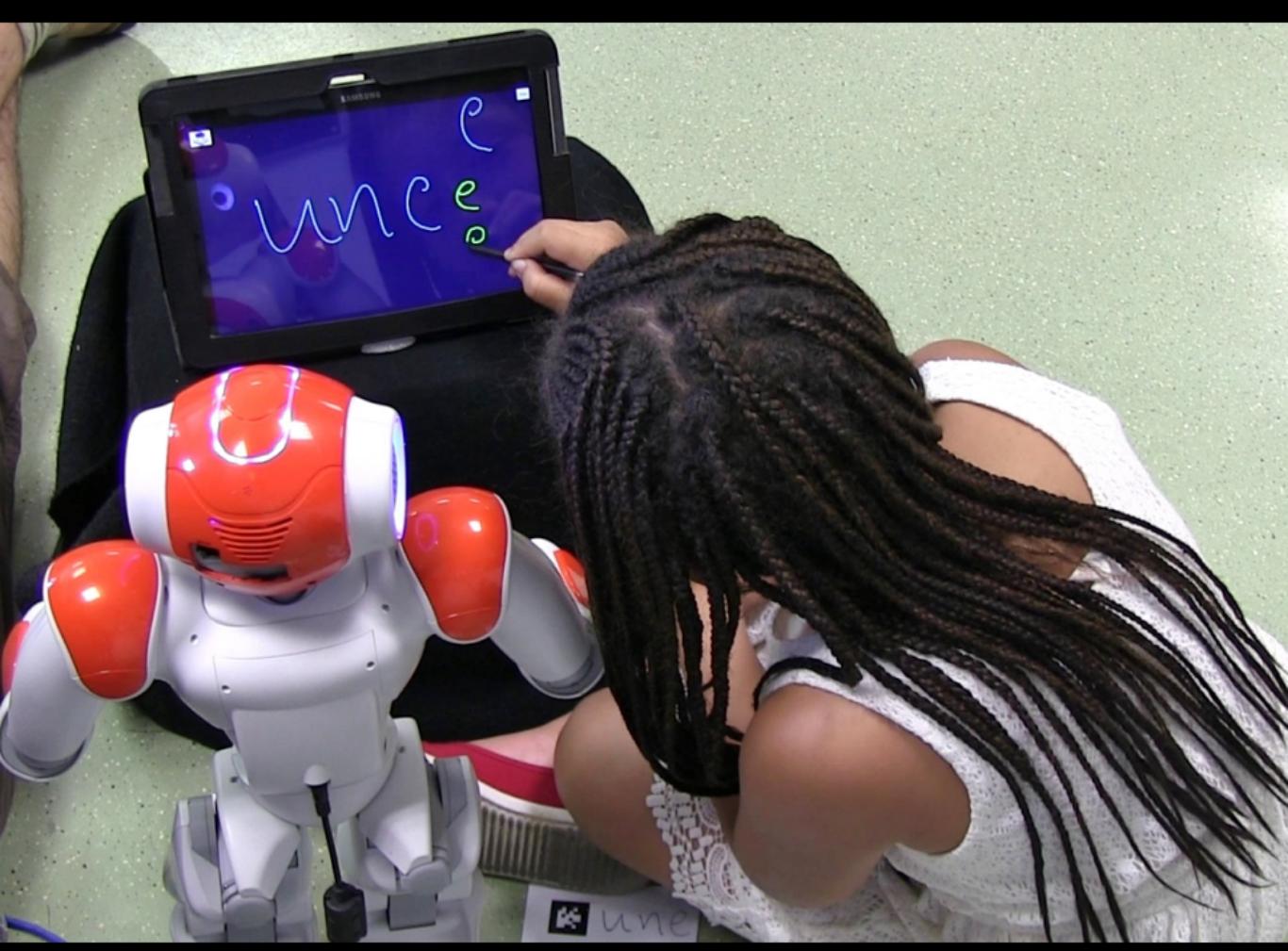
Concept 2: solar system

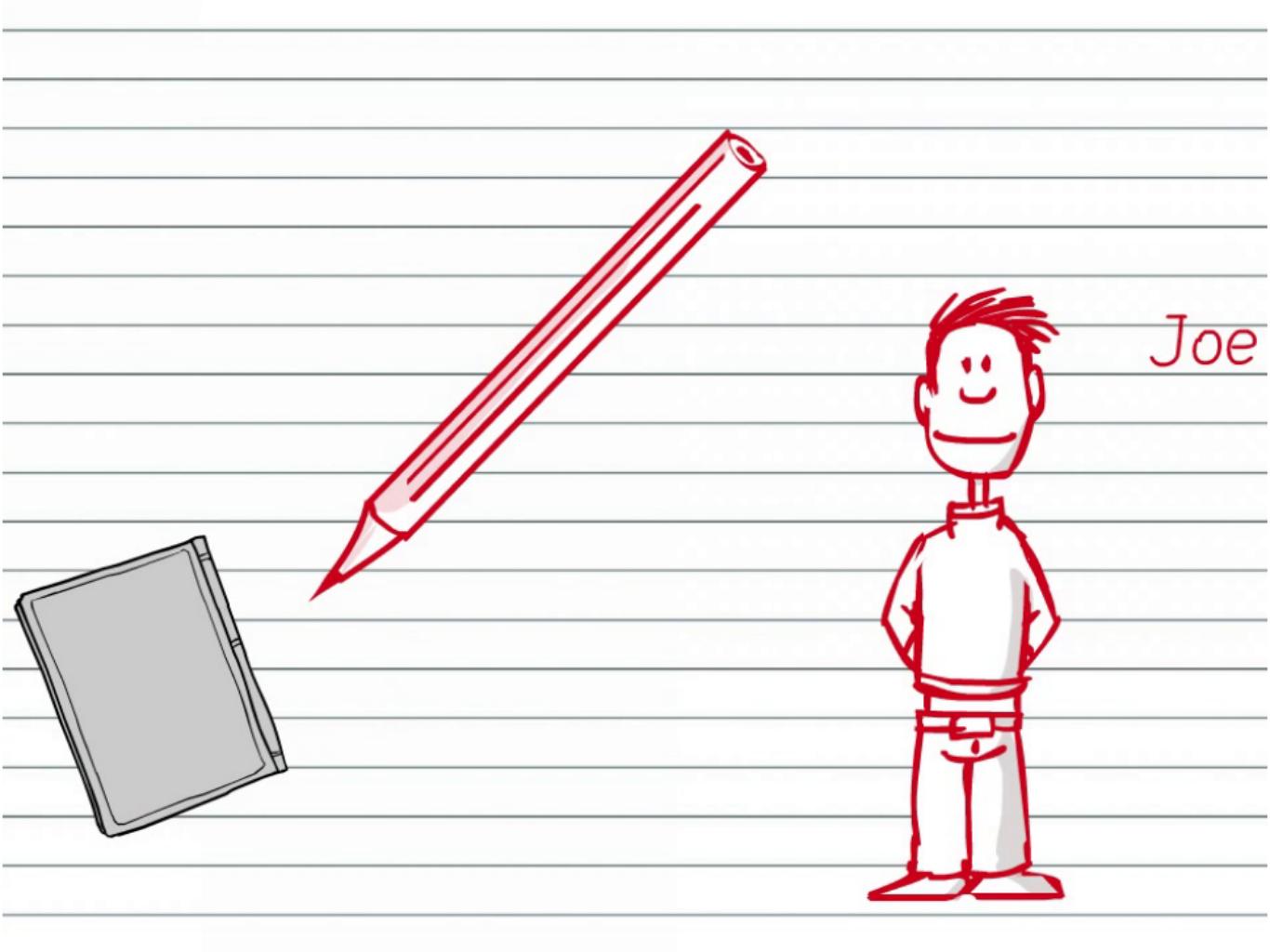


INTERACTION DESIGN SPACE



...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!

ROBOTS?

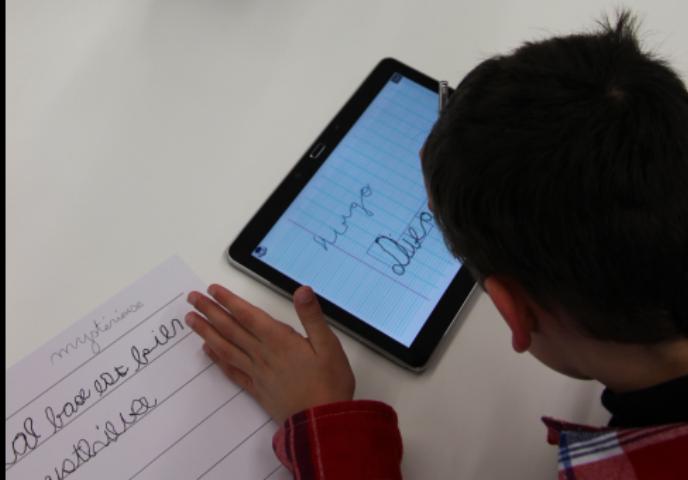
- Robots do not know how to write!
- Learning by teaching

ROBOTS?

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



Algunas personas
que viven en la
ciudad tienen que
comer en restaurantes
y no tienen tiempo
para cocinar.



mystérieuse
Al bâton est bâton
mystérieuse

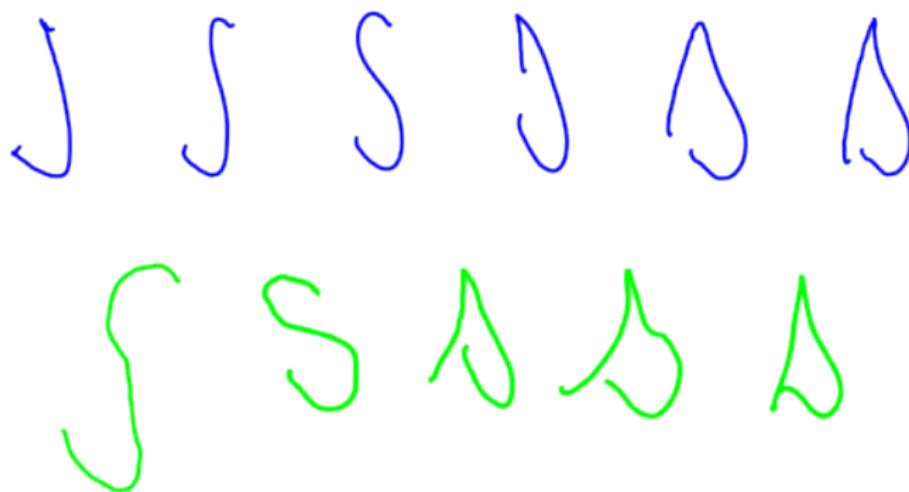
Mind modelling is **mutual**

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

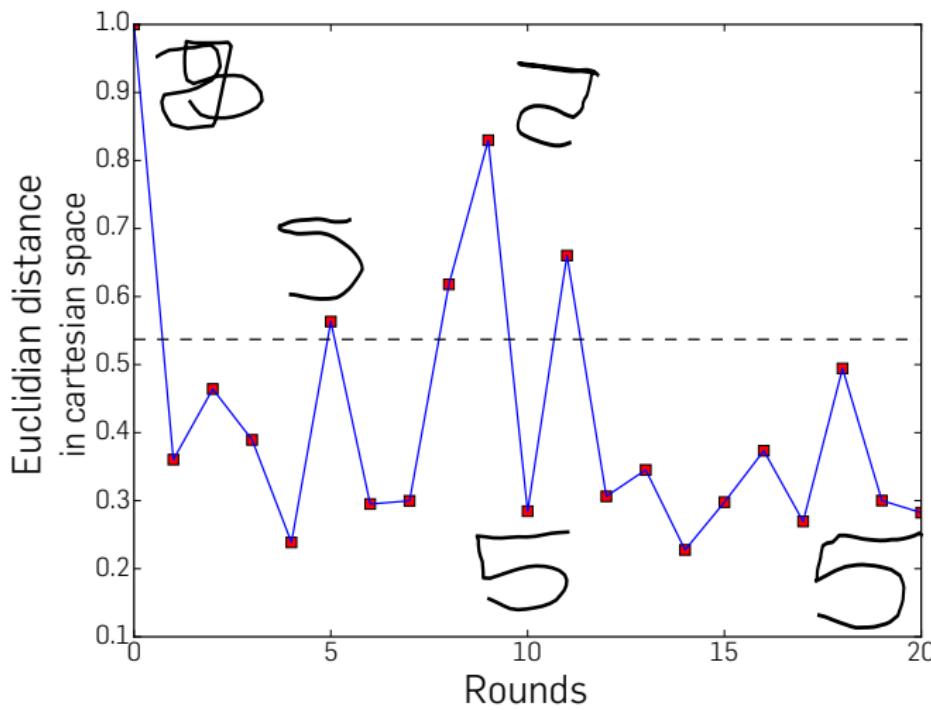
salut mimi
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LEARNING TO DRAW A 5



THE ROBOT AS A SOCIAL AGENT

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 - Protégé effect
 - metacognition

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- **The robot as a cognitive agent is key here**
 - 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?

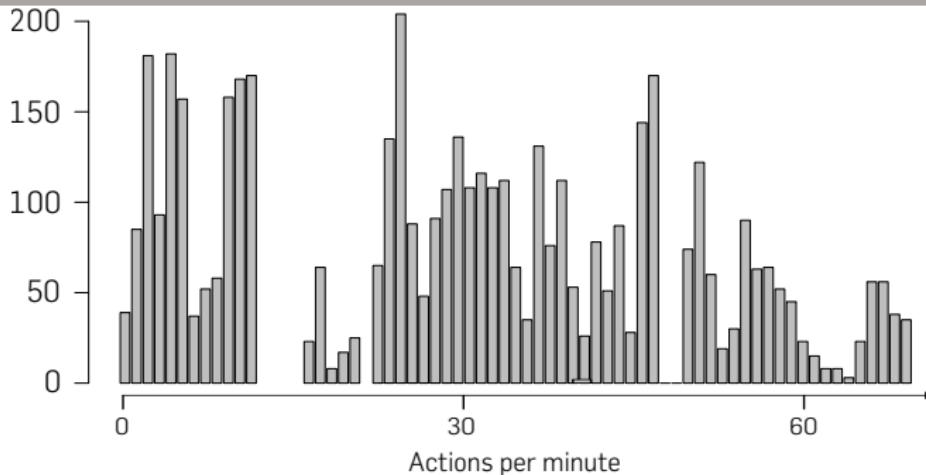
Thank you!

Séverin Lemaignan

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CHILD-ROBOT INTERACTION ON THE PRACTICAL SIDE





lightbar
 on_toy_added
 move
 background_blink
 undock
 pulse_row
 blink
 on_lolette
 placeeyes

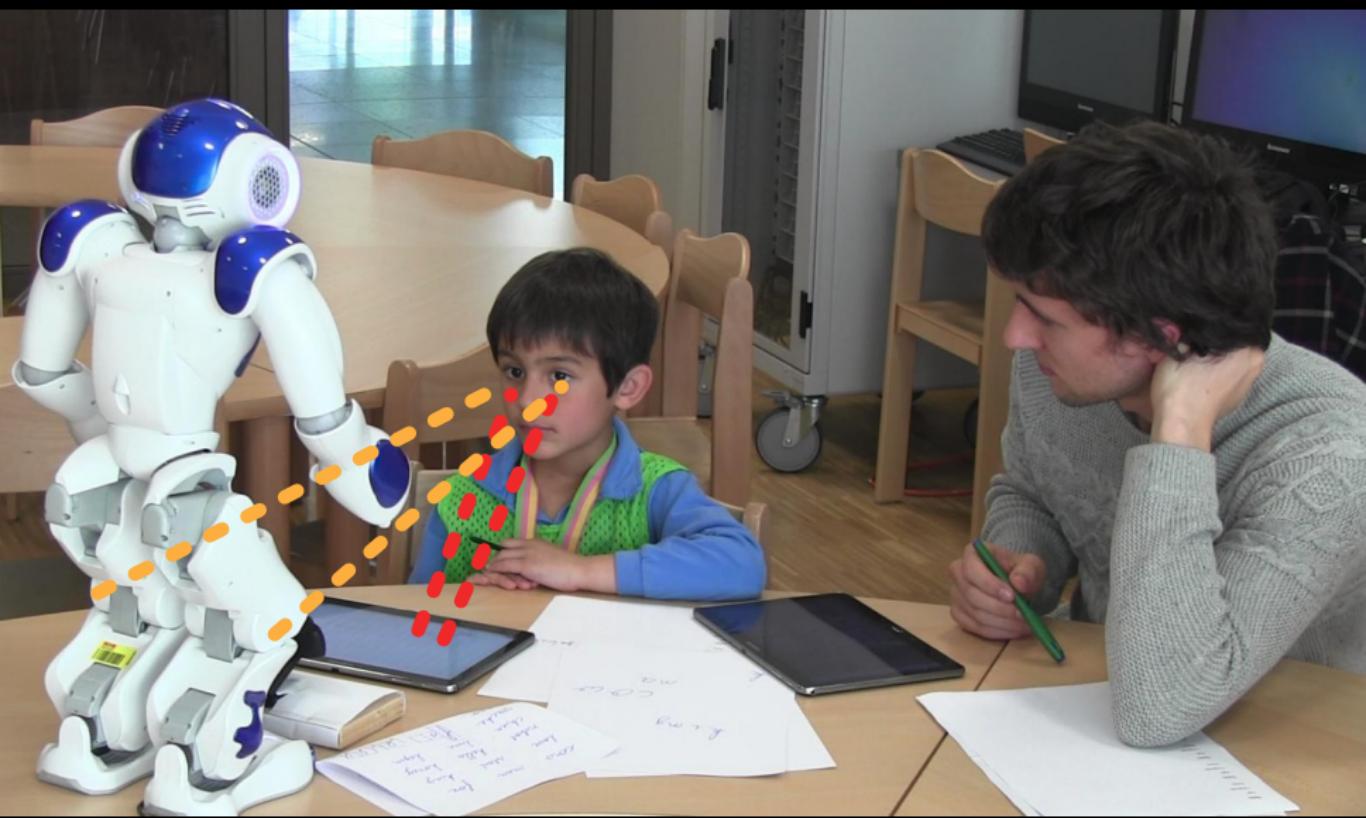
on_bumped
 up_down_row
 wakeup
 look_at_caresses
 on_toy_removed
 sneak_in
 on_lolette_removed
 fall_asleep
 look_at_lolette

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

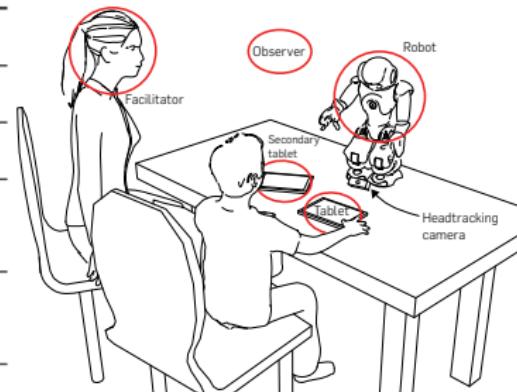


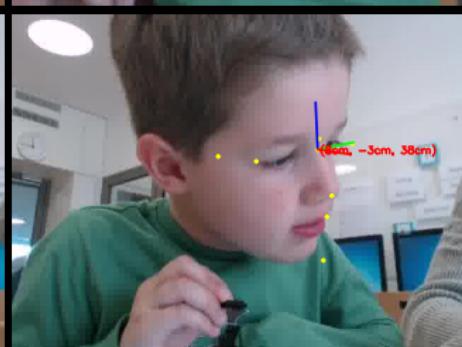
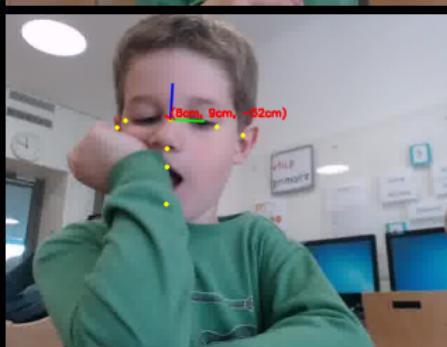
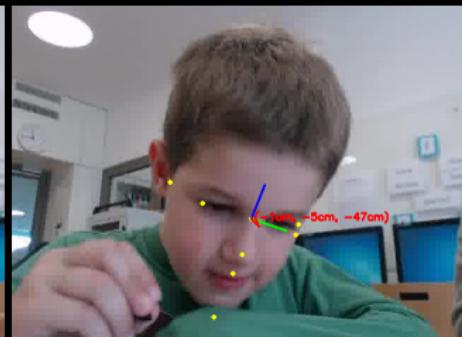


EXPECTED FOCUS

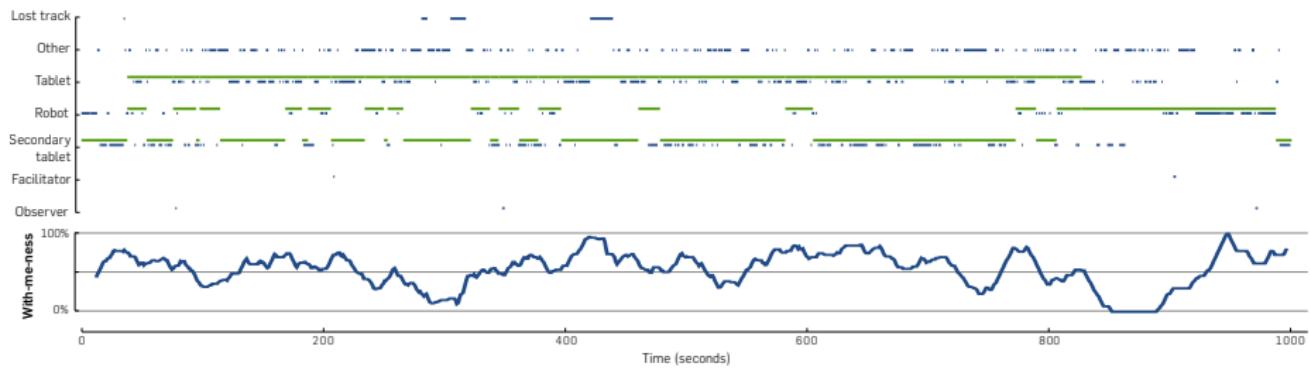
Example for the CoWriter task:

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)?

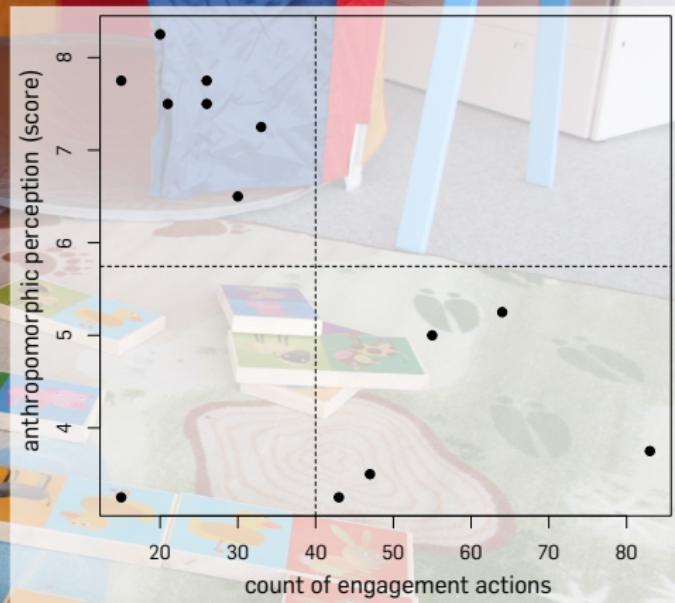
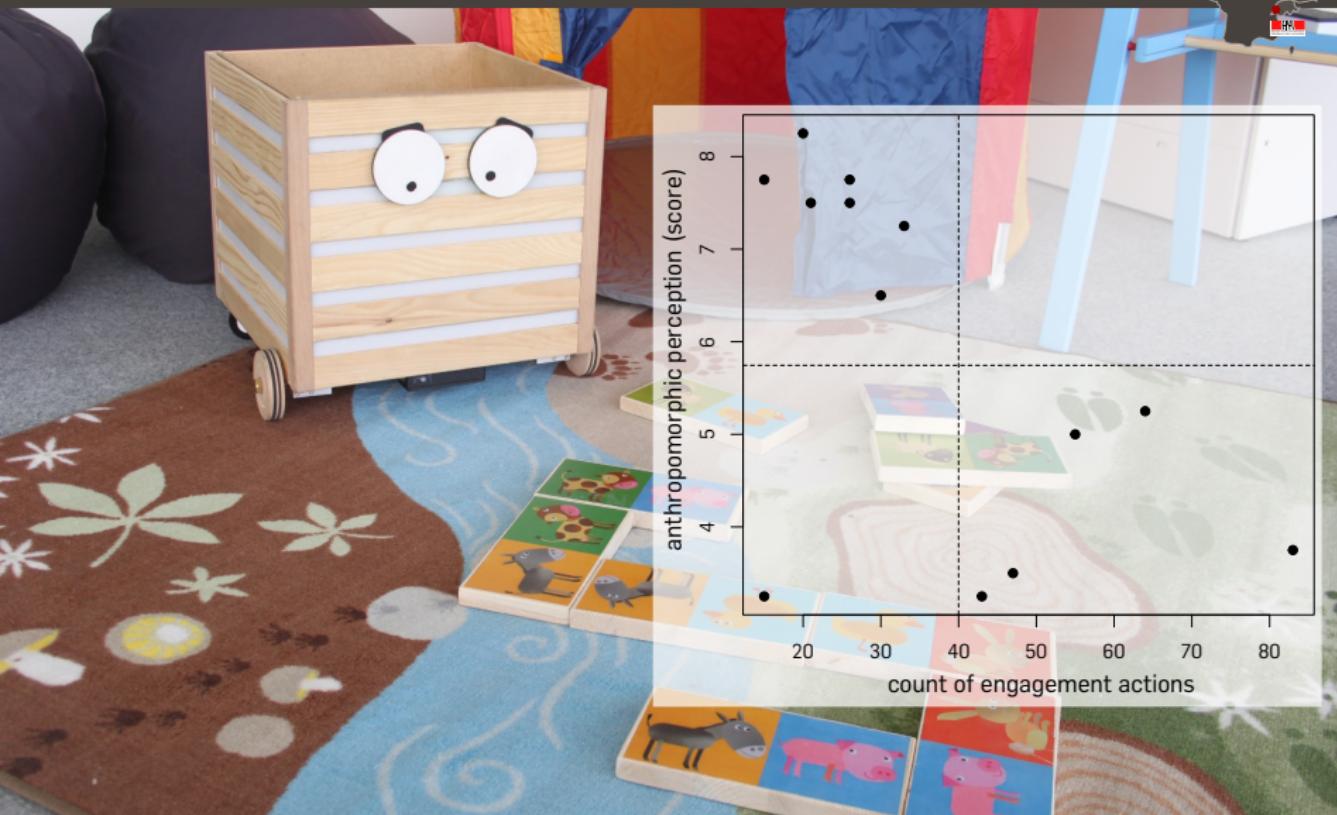
BEHAVIOUR VS PERCEPTION?

Any relation between the behavioural and perceptual measurements?



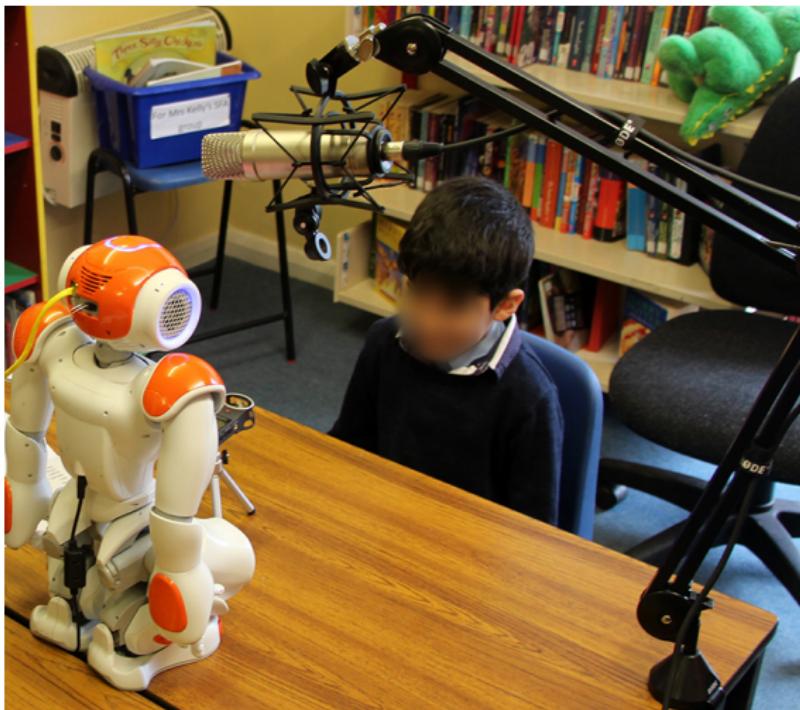
We can compute for each pair an “anthropomorphic perception” score based on the cognitive ascriptions, and...

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.
fixed (n=34)	0.34		<i>11.8 [38]</i>	0.64	<i>0 [0]</i>	0.68	<i>0 [0]</i>	0.76	<i>0 [0]</i>
spontaneous (n=222)	0.39		<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>
spontaneous clean only (n=83)	0.40		<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.