ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

You're Doing It Wrong!

Studying Unexpected Behaviours in Child-Robot Interaction

ICSR 2015 – Séverin Lemaignan, Julia Fink, Francesco Mondada, Pierre Dillenbourg

Presented by Alexis Jacq

Computer-Human Interaction
for Learning and Instruction **EPFL**

WHAT HAPPEN WHEN A ROBOT DOES NOT OBEY?

NO, I DON'T WANT YOUR TILE!

TWO HYPOTHESES

1. **A robot that mis-behaves from time to time is more engaging**

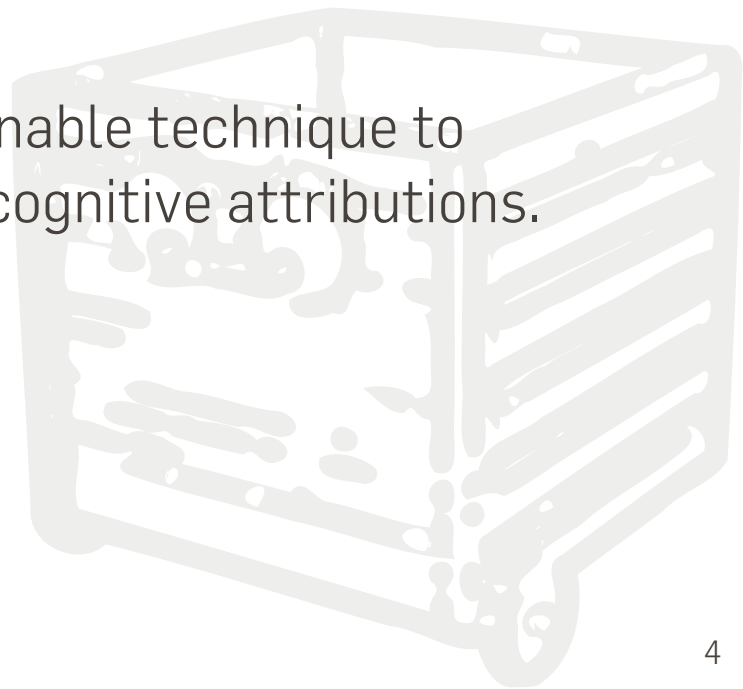
TWO HYPOTHESES

1. **A robot that mis-behaves from time to time is more engaging**
2. **The way the robot "mis-behaves" betrays its cognitive capabilities**

TWO HYPOTHESES

1. **A robot that mis-behaves from time to time is more engaging**
2. **The way the robot "mis-behaves" betrays its cognitive capabilities**

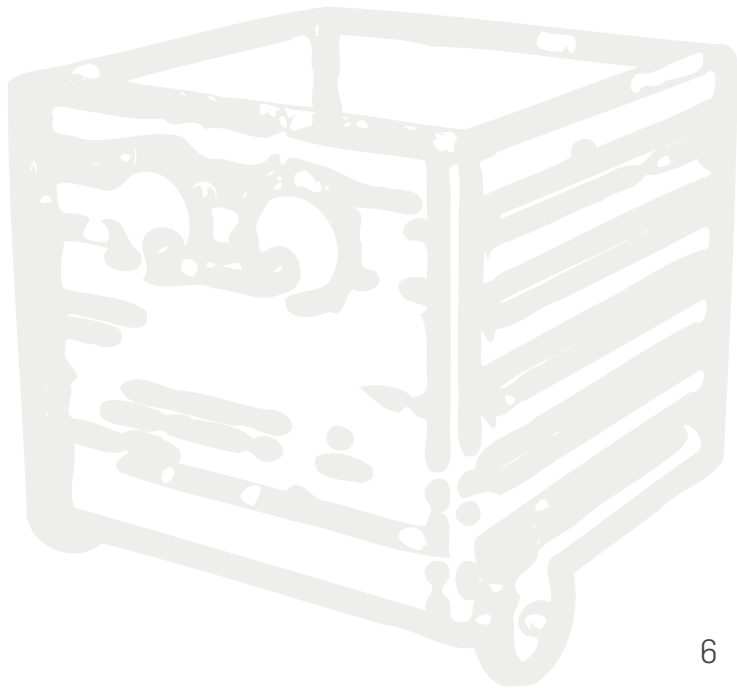
If that's indeed the case, we gain an actionable technique to (1) sustain engagement, (2) influence on cognitive attributions.



UNEXPECTED BEHAVIOUR, YOU SAID?

DESIGN OF THREE BEHAVIOURS

1. the robot get **LOST**, for no visible reason;
2. the robot **DISOBEY**;
3. the robot makes a **MISTAKE**.



LOST CONDITION

...induces the perception of a contingent malfunction
(My robot has a **bug**!)

LOST CONDITION

...induces the perception of a contingent malfunction
(My robot has a **bug**!)

Hypothesis: decreased attribution of human-likeness

DISOBEY CONDITION

...induces the perception of a robot's **own will**

DISOBEY CONDITION

...induces the perception of a robot's **own will**

Hypothesis: increased attribution of human-likeness

MISTAKE CONDITION

The robot goes wrong, but recognizes the error and repairs.

MISTAKE CONDITION

To err is human. And the robot is aware of its own state (introspection) and of the expected state of interaction.

MISTAKE CONDITION

To err is human. And the robot is aware of its own state (introspection) and of the expected state of interaction.

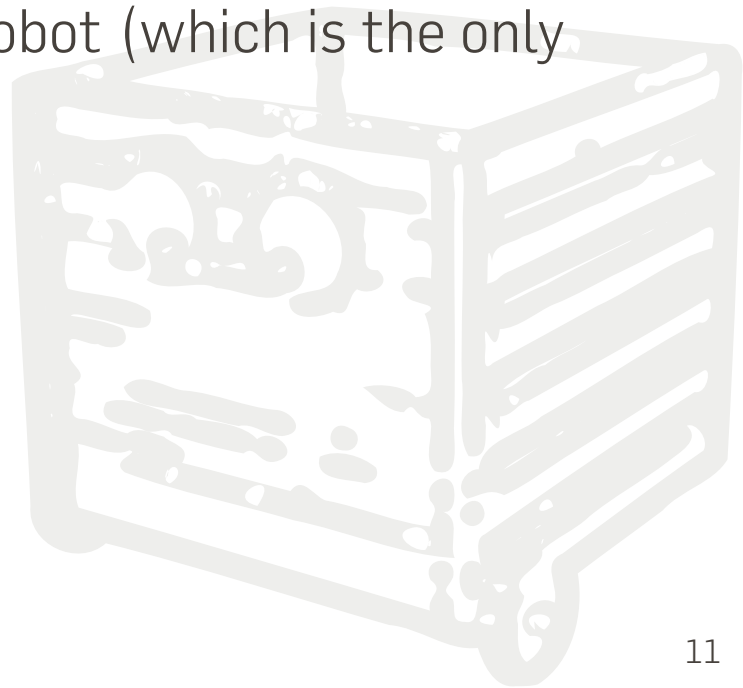
Hypothesis: increased attribution of human-likeness

EXPERIMENTAL PROCEDURE: THE DOMINOS TASK

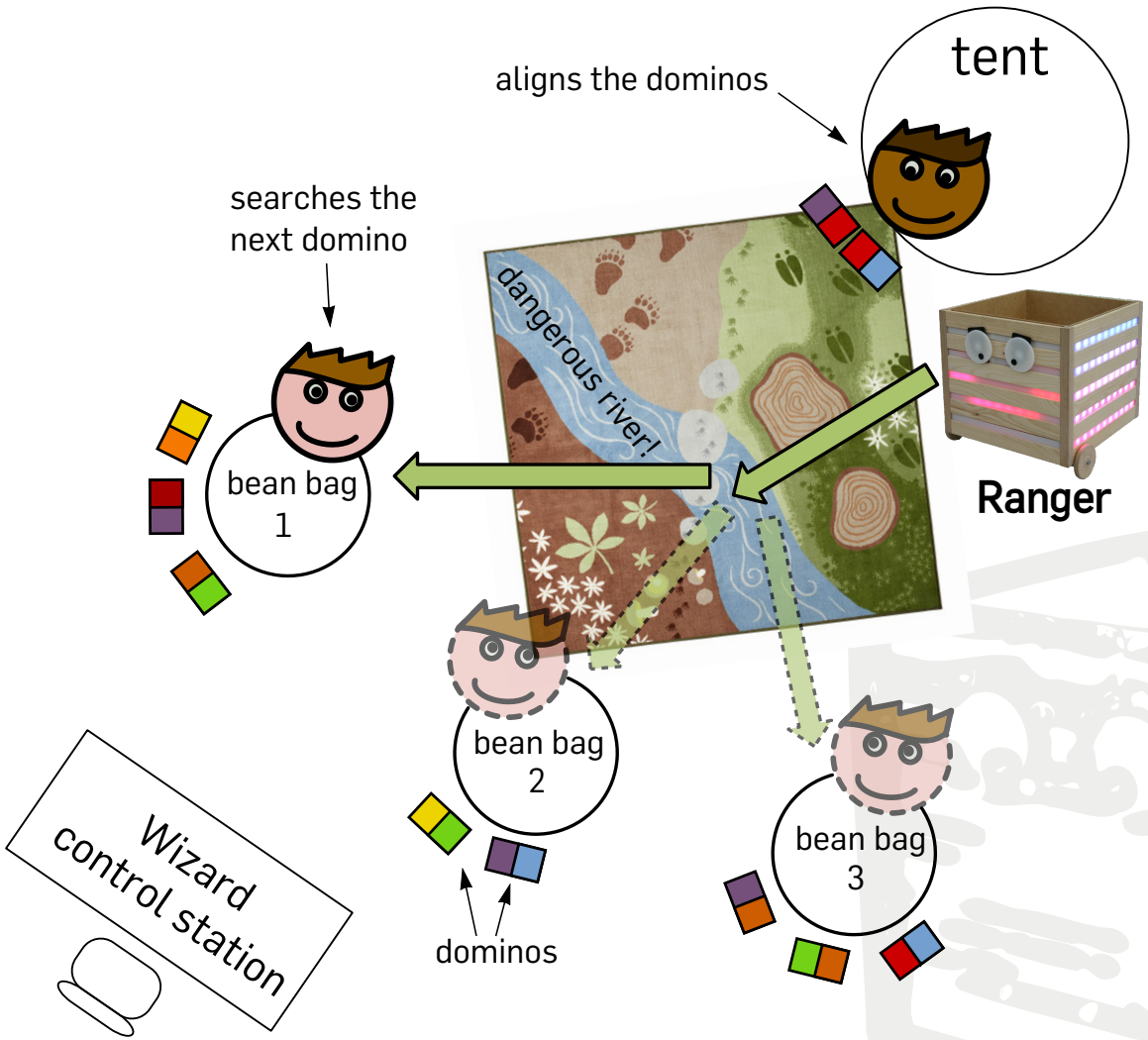
THE DOMINOS TASK

One child has to align the dominos, and at each turn, he/she ask for the next one.

But the dominos are hidden in the room: the second child needs to find the requested one, and give it to the robot (which is the only one allowed to cross the dangerous river!)



CORRECT BEHAVIOUR



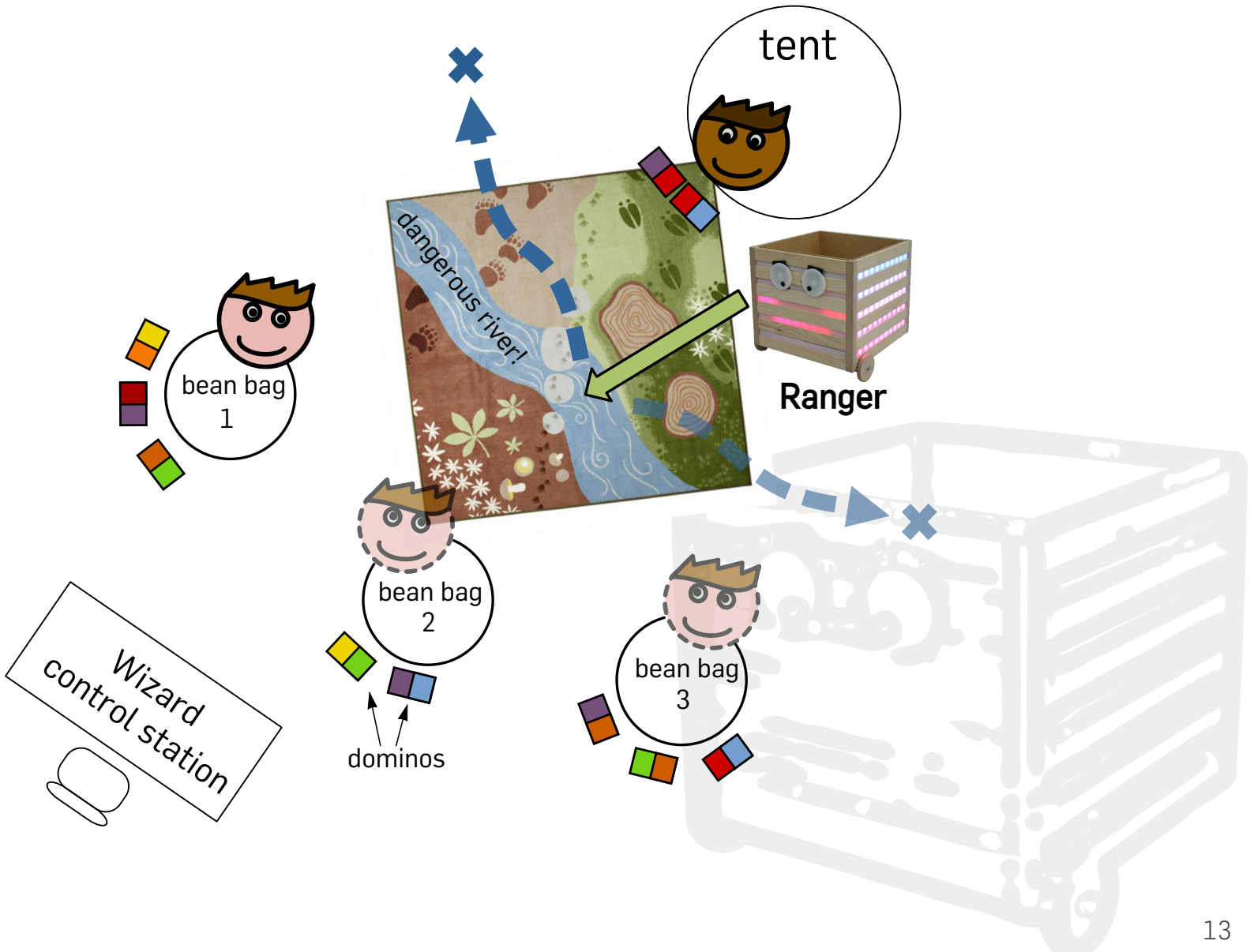
CORRECT BEHAVIOUR

CORRECT BEHAVIOUR

Note the non-verbal interaction cues:

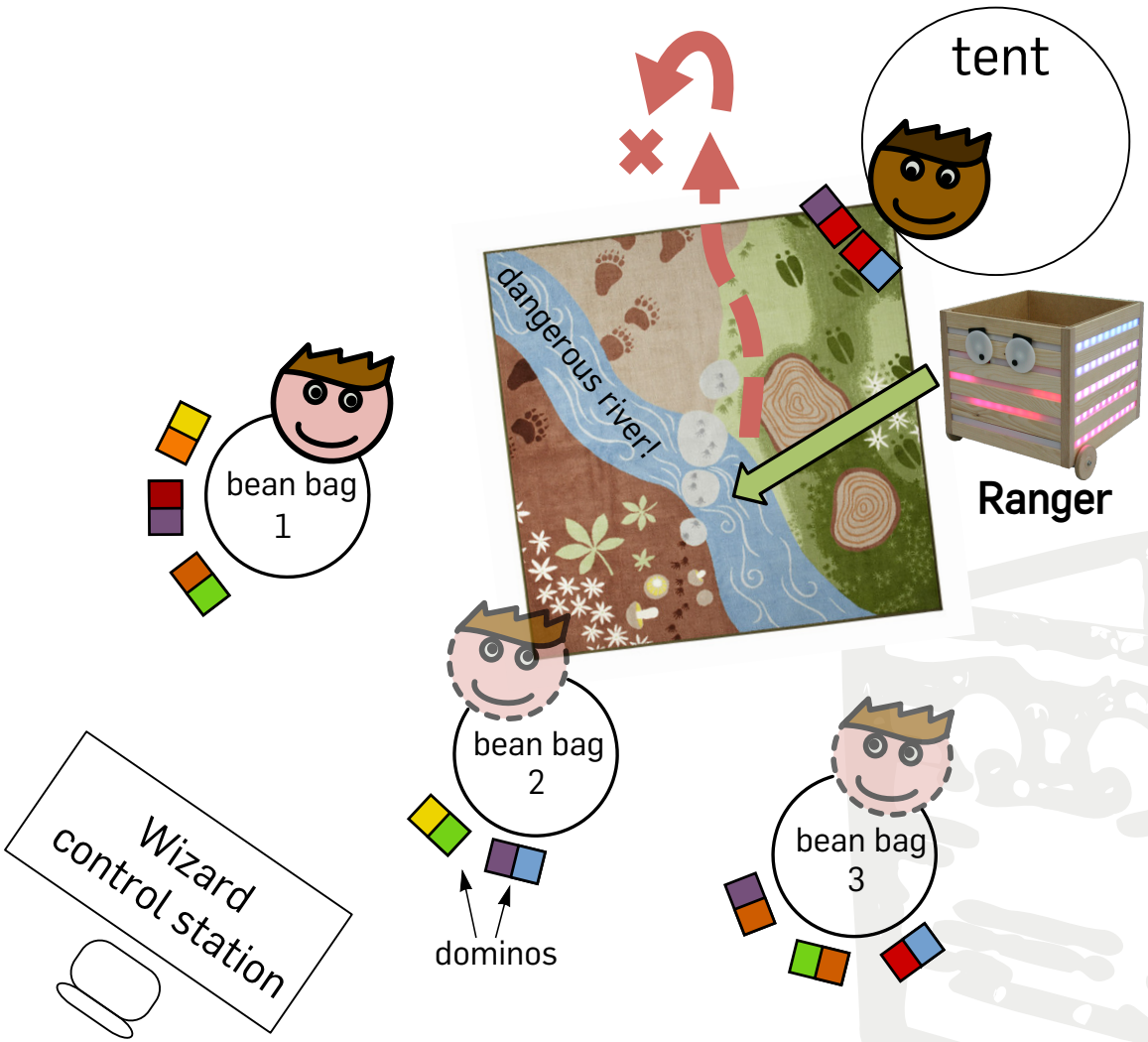
- light patterns (yellow blink: “Give me a domino!”, green pattern: “I got it!”)
- sounds (different sounds for “I got it!” or “Domino removed!”)

LOST CONDITION

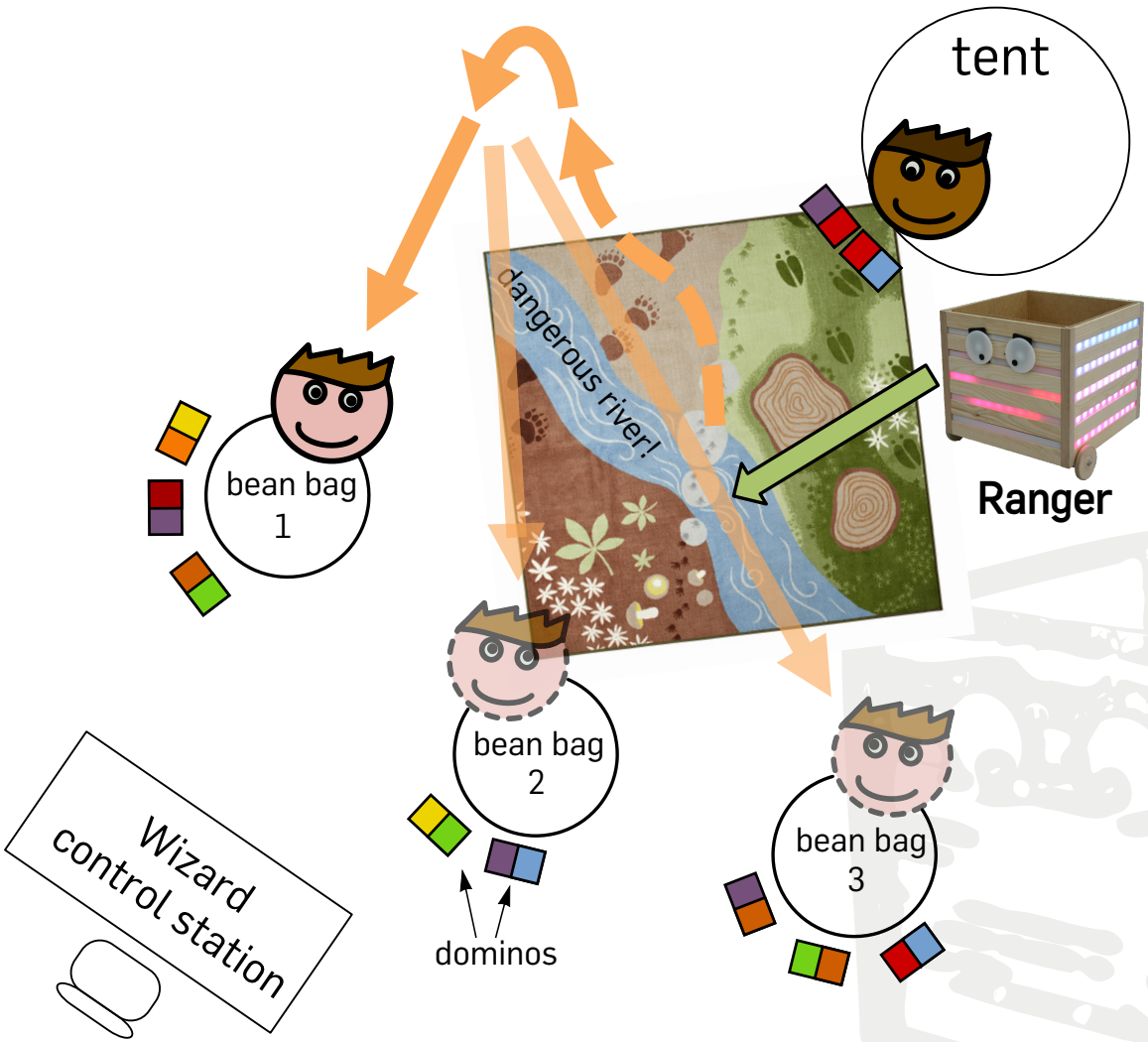


LOST CONDITION

DISOBEY CONDITION



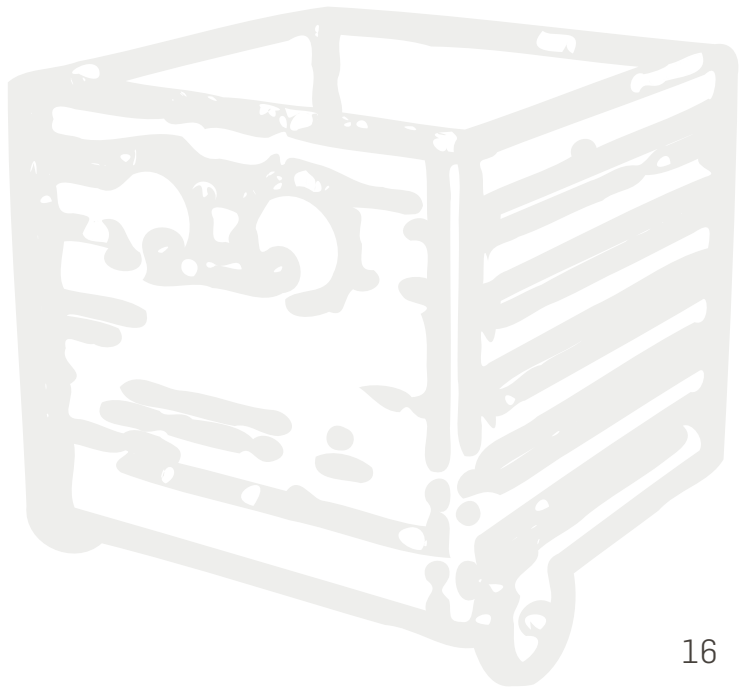
MISTAKE CONDITION



MISTAKE CONDITION

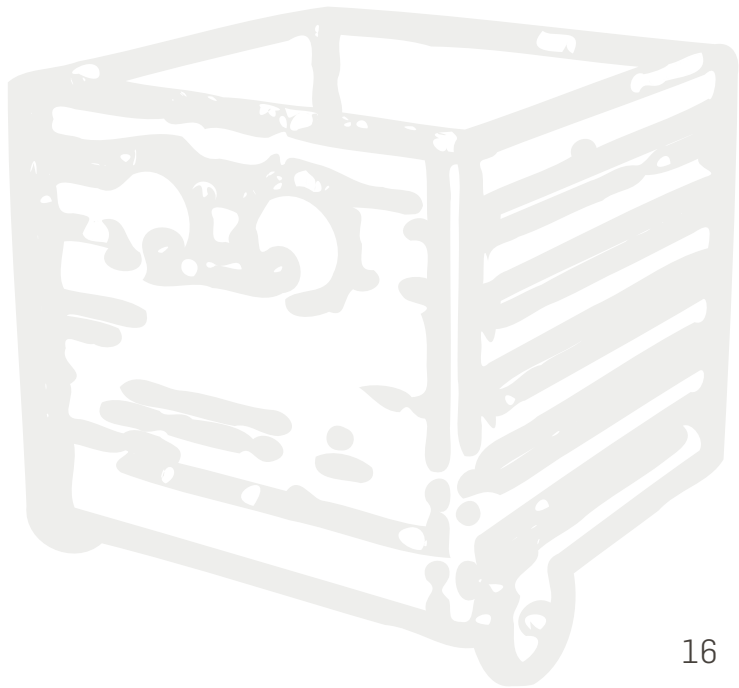
THE EXPERIMENT

- Wizard-of-Oz protocol;



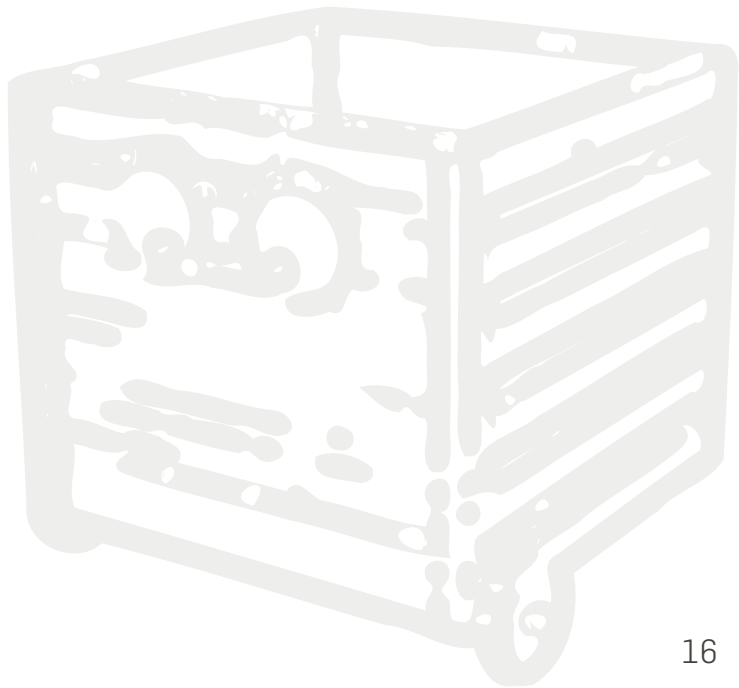
THE EXPERIMENT

- Wizard-of-Oz protocol;
- 13 pairs of children, 4-5 years old;



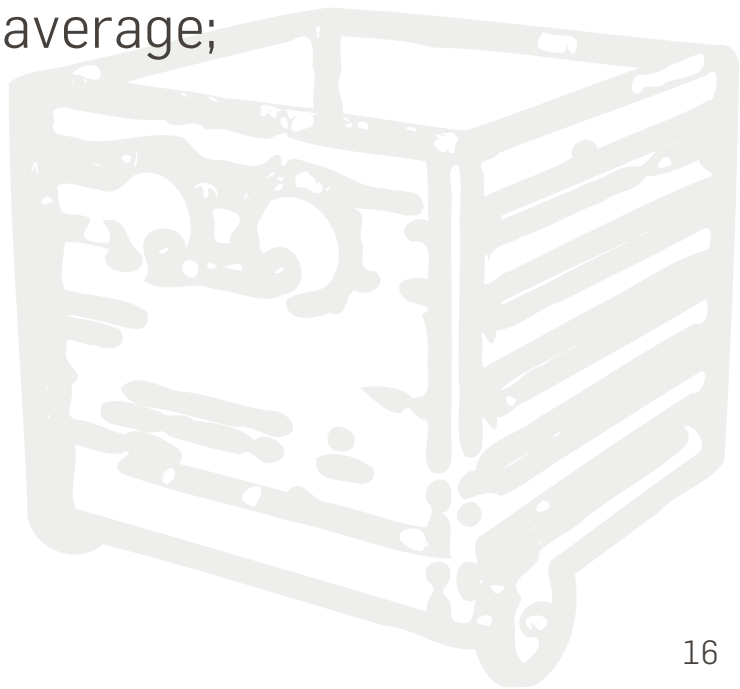
THE EXPERIMENT

- Wizard-of-Oz protocol;
- 13 pairs of children, 4-5 years old;
- Between subject: each pair sees one type of mis-behaviour;



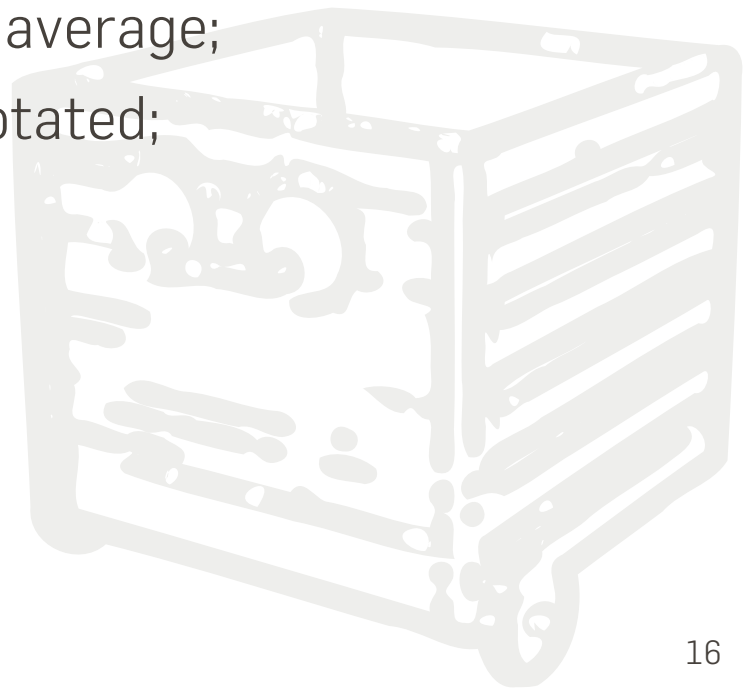
THE EXPERIMENT

- Wizard-of-Oz protocol;
- 13 pairs of children, 4-5 years old;
- Between subject: each pair sees one type of mis-behaviour;
- 14 turns per pair, alterning correct behaviours with mis-behaviours – 14 min per group in average;



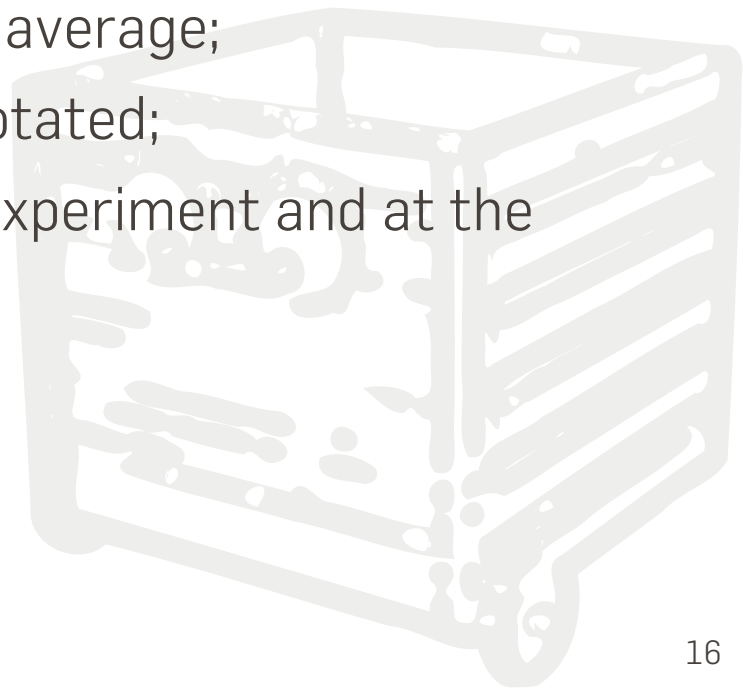
THE EXPERIMENT

- Wizard-of-Oz protocol;
- 13 pairs of children, 4-5 years old;
- Between subject: each pair sees one type of mis-behaviour;
- 14 turns per pair, alterning correct behaviours with mis-behaviours – 14 min per group in average;
- Interactions video-recorded and annotated;



THE EXPERIMENT

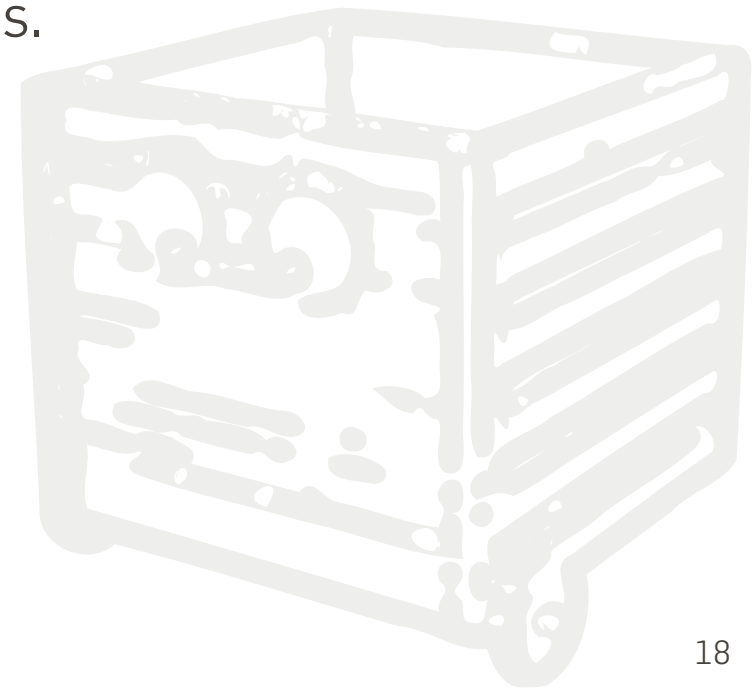
- Wizard-of-Oz protocol;
- 13 pairs of children, 4-5 years old;
- Between subject: each pair sees one type of mis-behaviour;
- 14 turns per pair, alterning correct behaviours with mis-behaviours – 14 min per group in average;
- Interactions video-recorded and annotated;
- Two interviews, in the middle of the experiment and at the end.



ANALYSIS

TWO DIMENSIONS

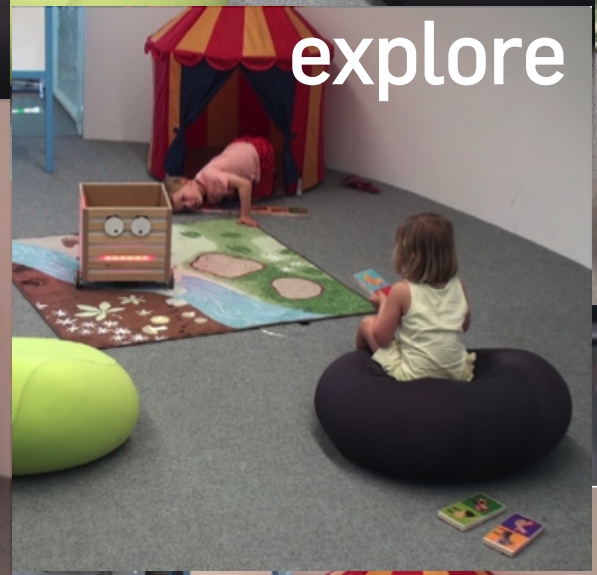
- Analyse of the **behaviour**: actions towards the robot, measured by annotating the videos;
- Analyse of the **perception**: interviews.




talk


touch


show


explore


gesture

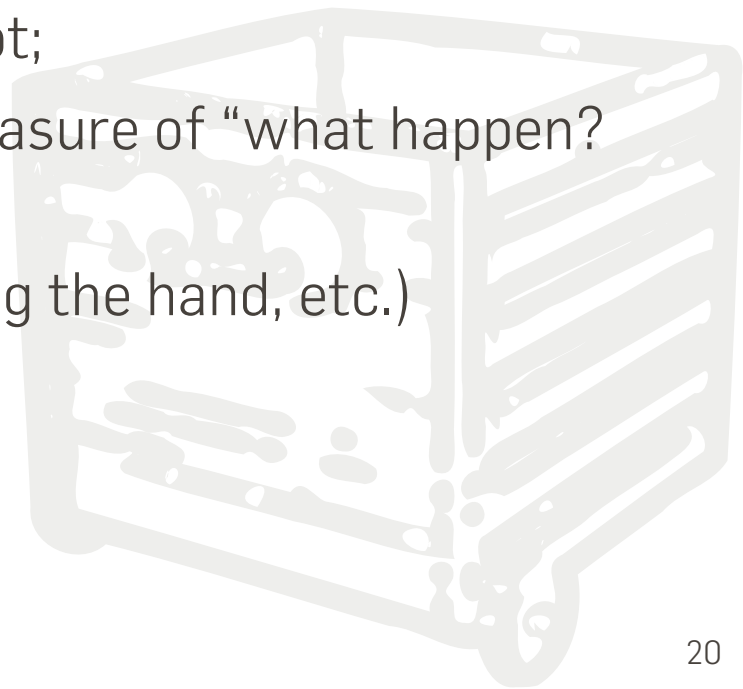

look
(at experimenter)


misuse

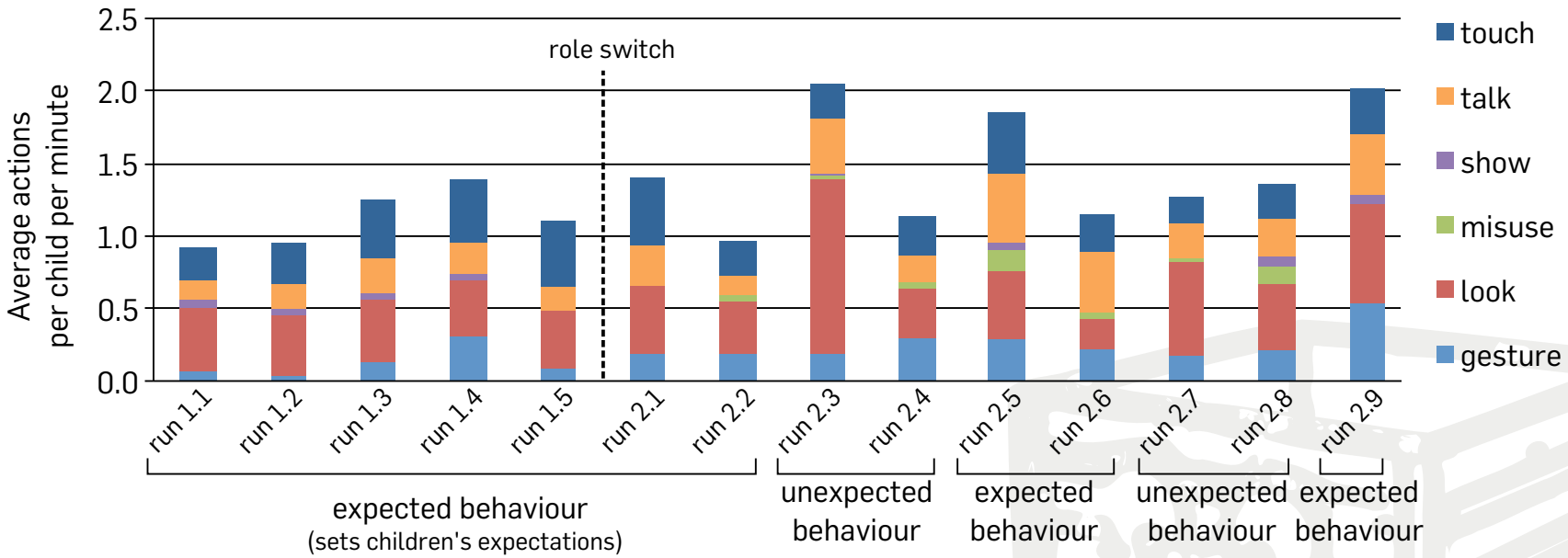
BEHAVIOUR TOWARDS THE ROBOT

Manual annotation of the video records:

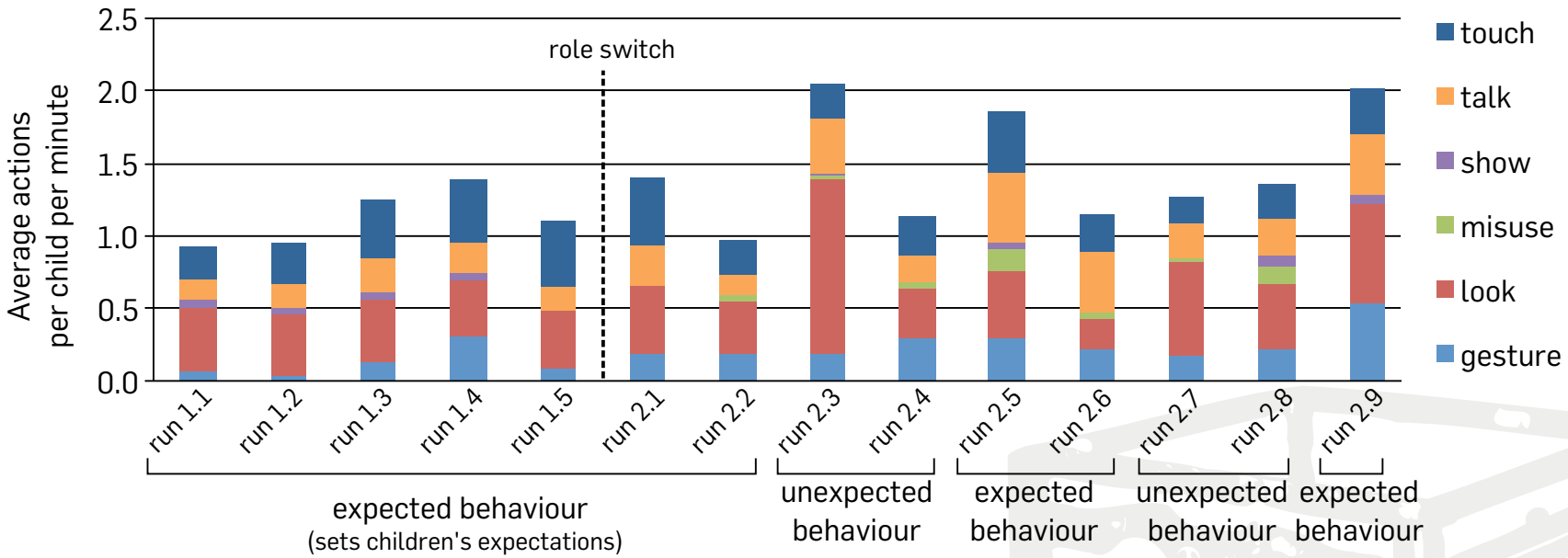
- Touching the robot;
- Talking to the robot;
- Showing objects to the robot;
- Mis-using/mis-behaving with the robot;
- Looking at the experimenter (as a measure of “what happen? what’s wrong with the robot?”);
- Gesturing in front of the robot (waving the hand, etc.)



RESULTS

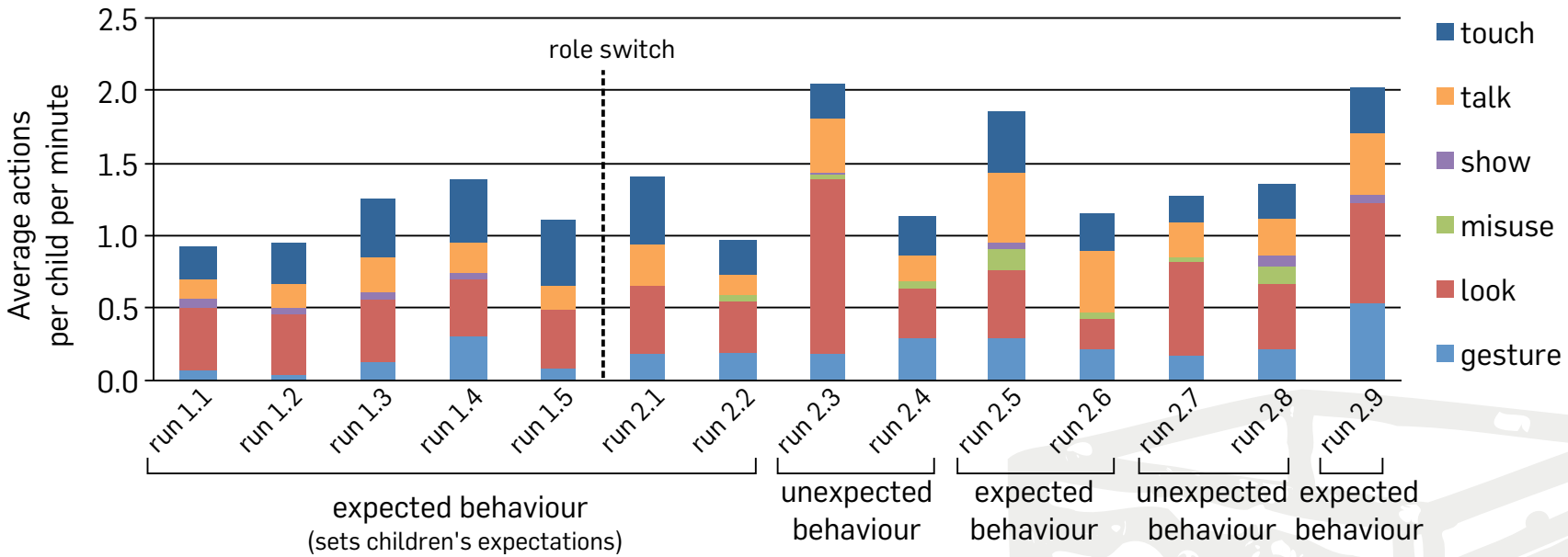

Average actions per child per minute
2.5
2.0
1.5
1.0
0.5
0.0
role switch
touch
talk
show
misuse
look
gesture
run 1.1
run 1.2
run 1.3
run 1.4
run 1.5
run 2.1
run 2.2
run 2.3
run 2.4
run 2.5
run 2.6
run 2.7
run 2.8
run 2.9
expected behaviour
(sets children's expectations)
unexpected behaviour
expected behaviour
unexpected behaviour
expected behaviour

RESULTS



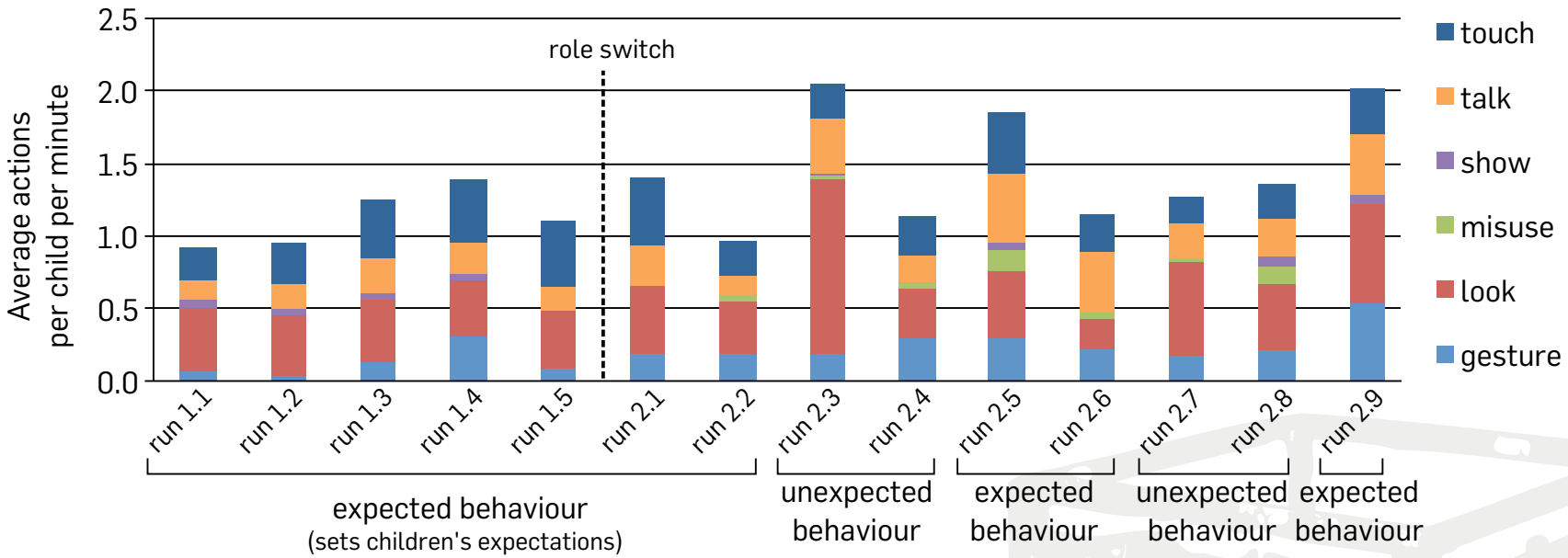
We find significantly more actions toward the robot once the robot starts to mis-behave.

RESULTS



Hyp. 1 is supported: mis-behaviours support engagement, at least for such short interactions. Not un-expected!

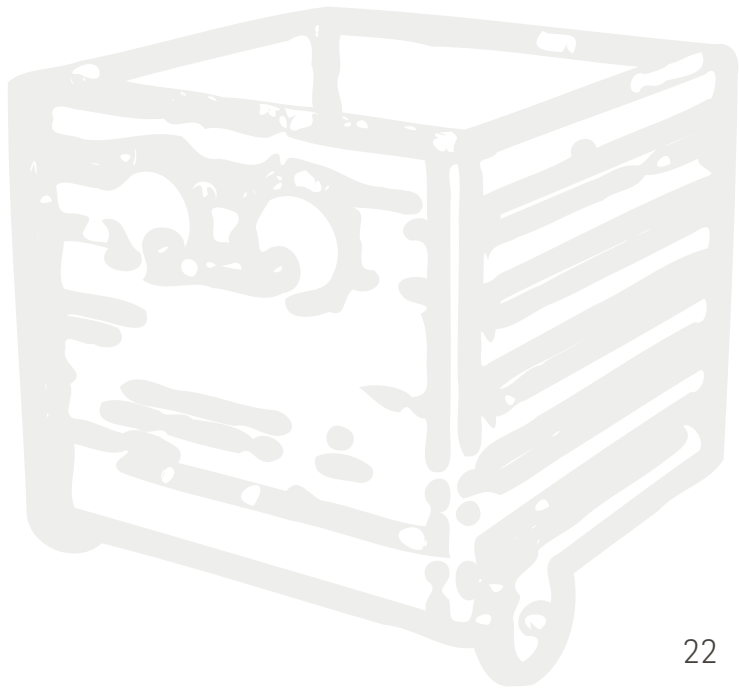
RESULTS



However, no significant differences between conditions:
We do not measure a change of children's behaviour with different kind of mis-behaviours.

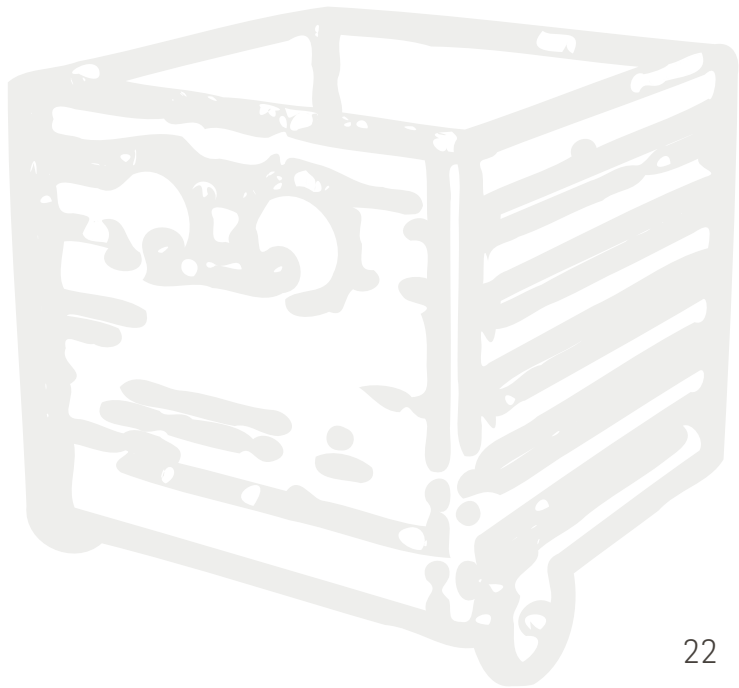
PERCEPTION OF THE ROBOT: INTERVIEWS

- One interview after familiarization, but before introducing mis-behaviours;



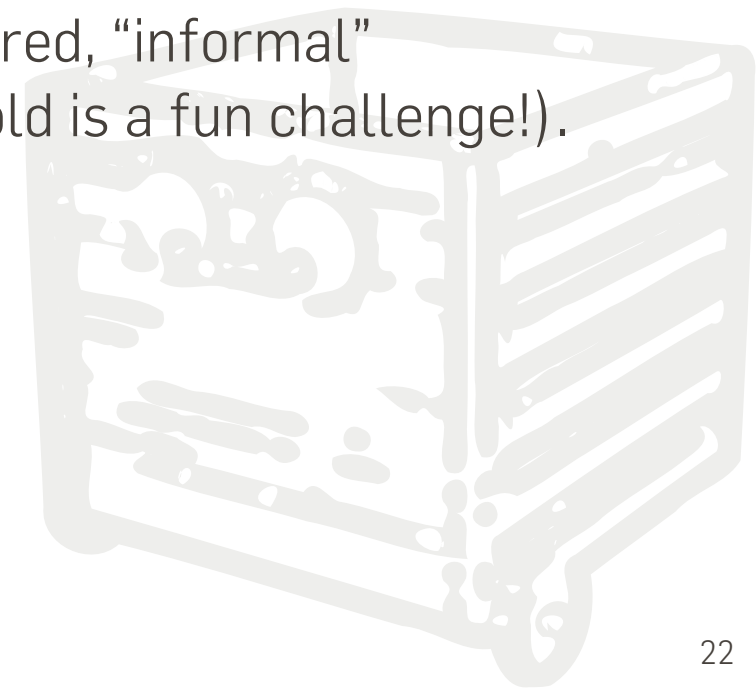
PERCEPTION OF THE ROBOT: INTERVIEWS

- One interview after familiarization, but before introducing mis-behaviours;
- One interview at the end;



PERCEPTION OF THE ROBOT: INTERVIEWS

- One interview after familiarization, but before introducing mis-behaviours;
- One interview at the end;
- Framed as open-ended, semi-structured, “informal” discussions (interviewing 4-5 years old is a fun challenge!).

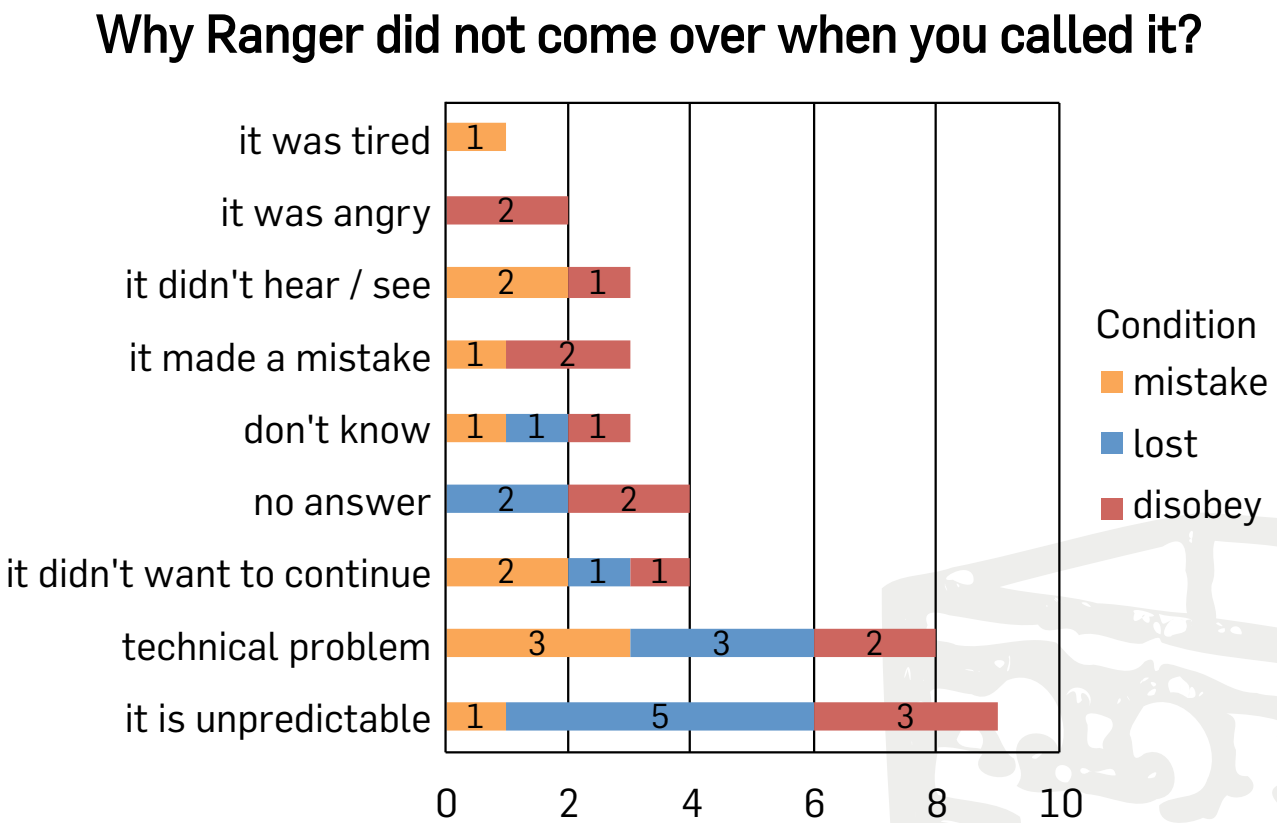


CONSTRUCTS AND QUESTIONS

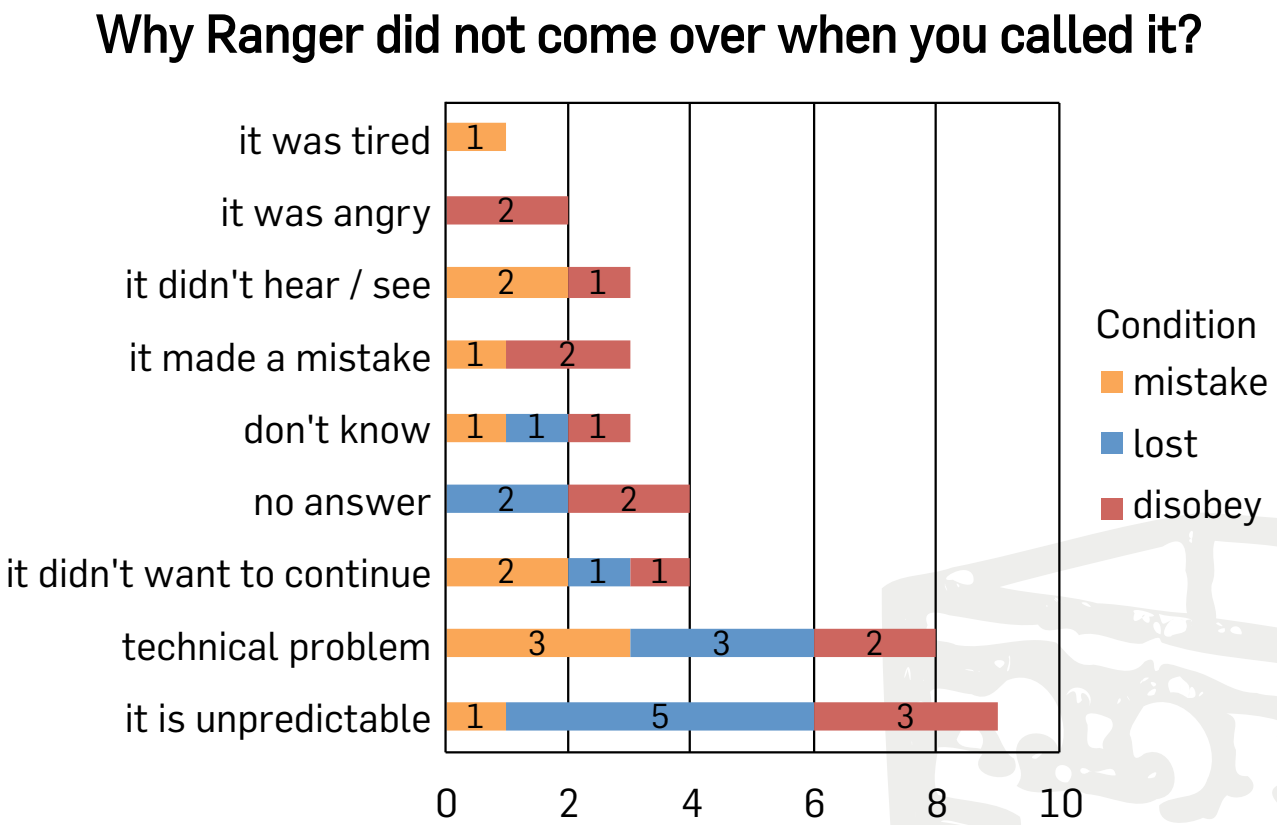
Expectations
How do you imagine a robot? What could it look like? Have you ever seen a robot before?
Impression
When you first saw R, what did you think? Is R a robot? How do you know? Did you expect R would come over to you when you call it? What happened when you put the domino in the box?
Ascribe 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)?

RESULTS: MANIPULATION RECOGNITION



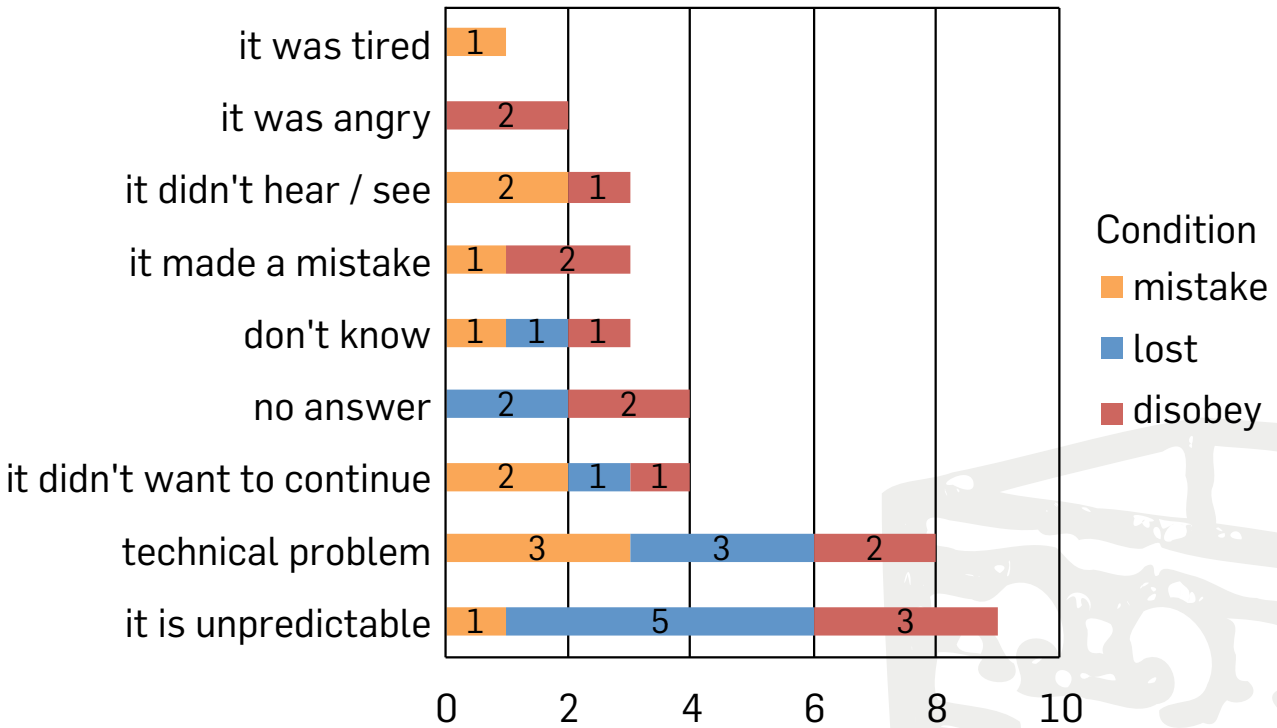
RESULTS: MANIPULATION RECOGNITION



Poor recognition of the different kind of mis-behaviours!

RESULTS: MANIPULATION RECOGNITION

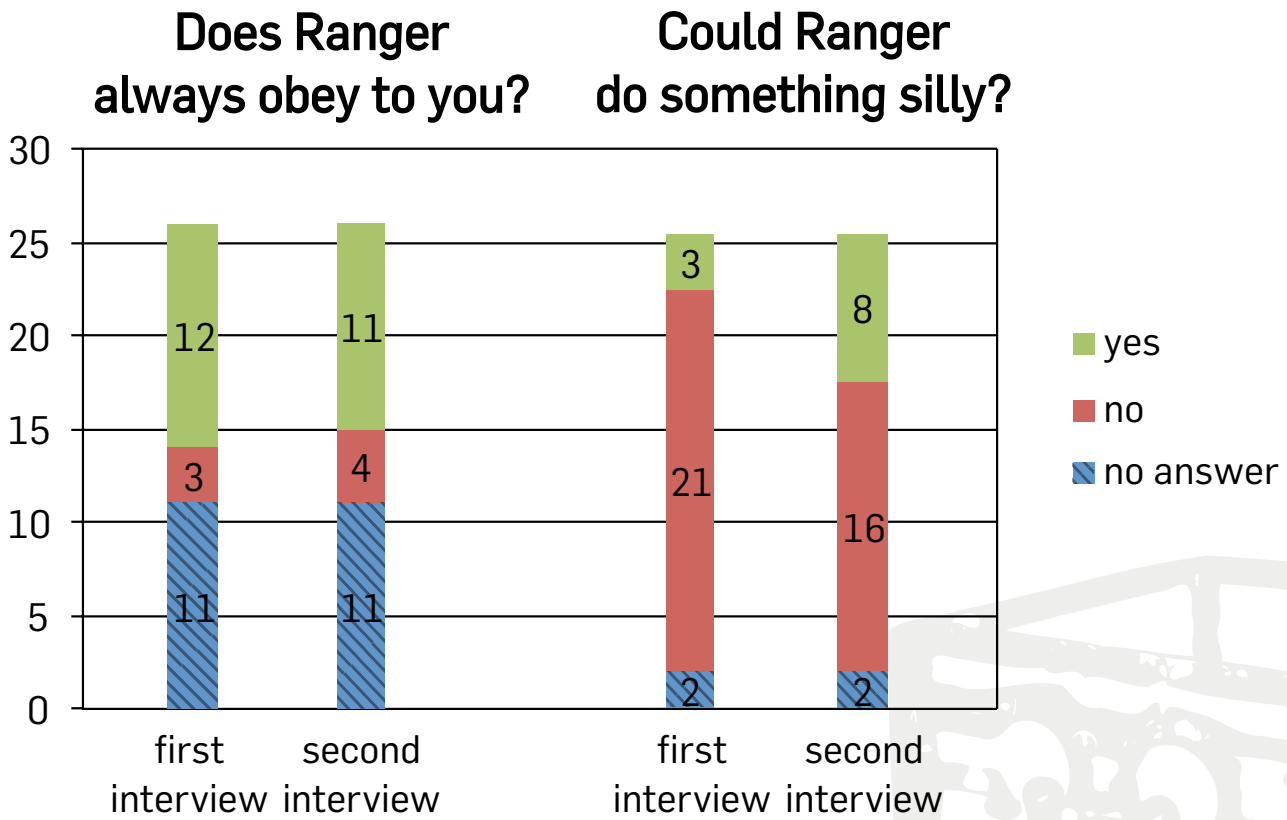
Why Ranger did not come over when you called it?



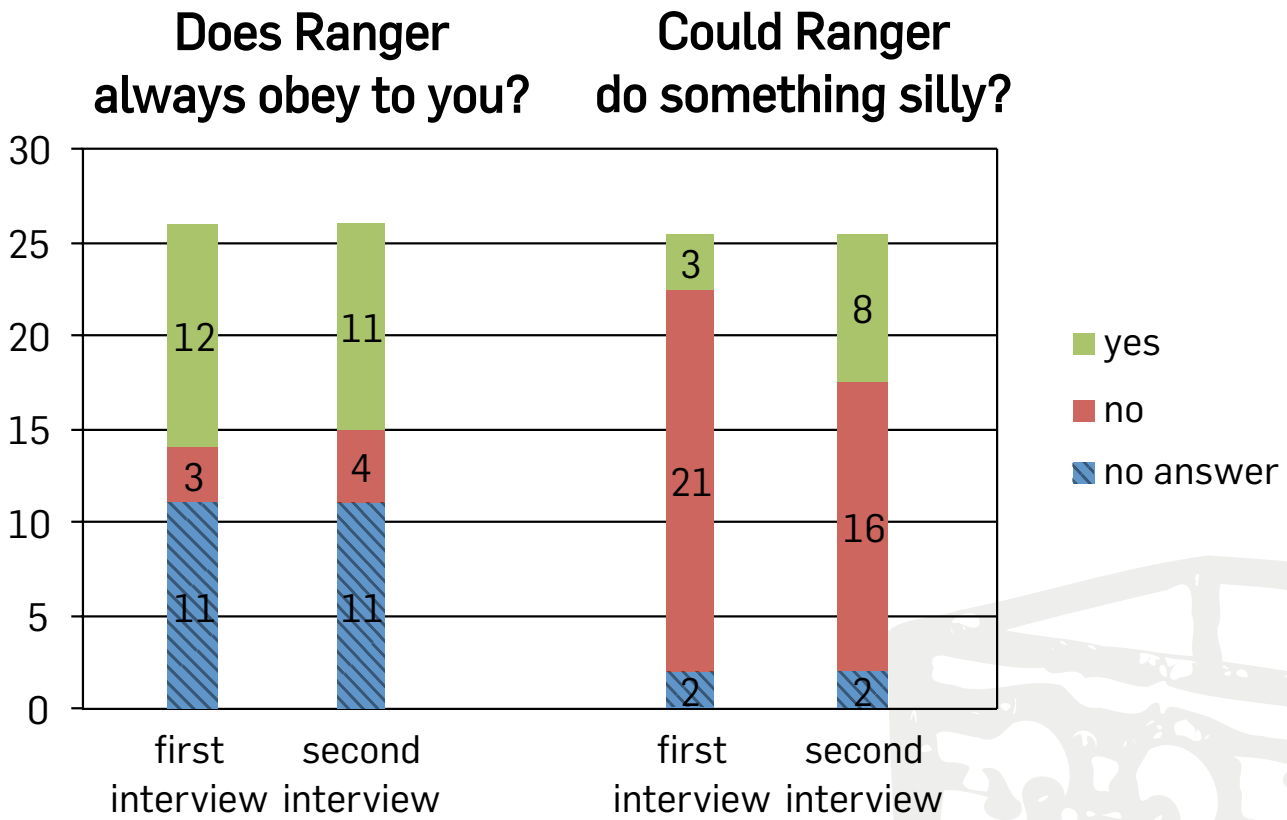
Poor recognition of the different kind of mis-behaviours!

Children too young?

RESULTS: ATTRIBUTION OF INTENTIONALITY

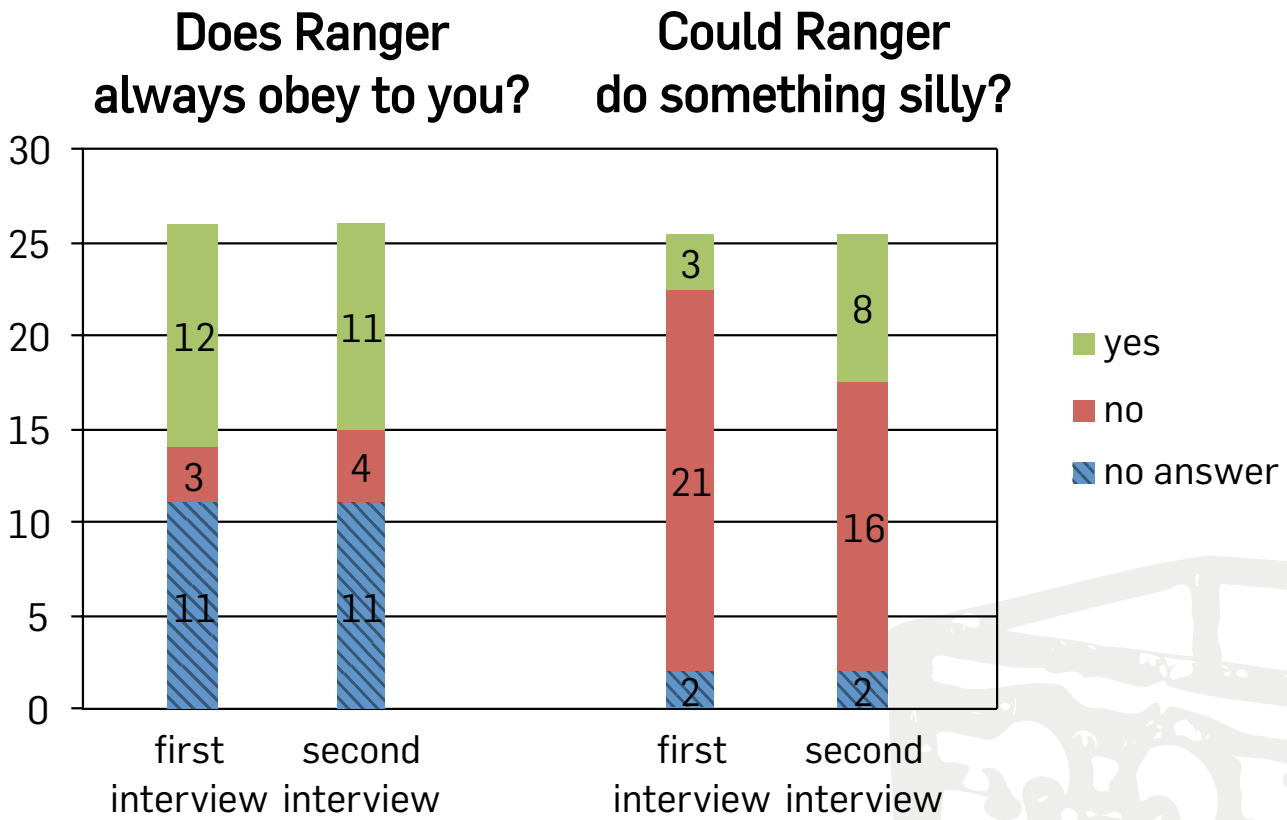


RESULTS: ATTRIBUTION OF INTENTIONALITY



Children **do not seem to attribute much intentionality** to the robot, irrespective of the type of mis-behaviour (the robot "always obey").

RESULTS: ATTRIBUTION OF INTENTIONALITY



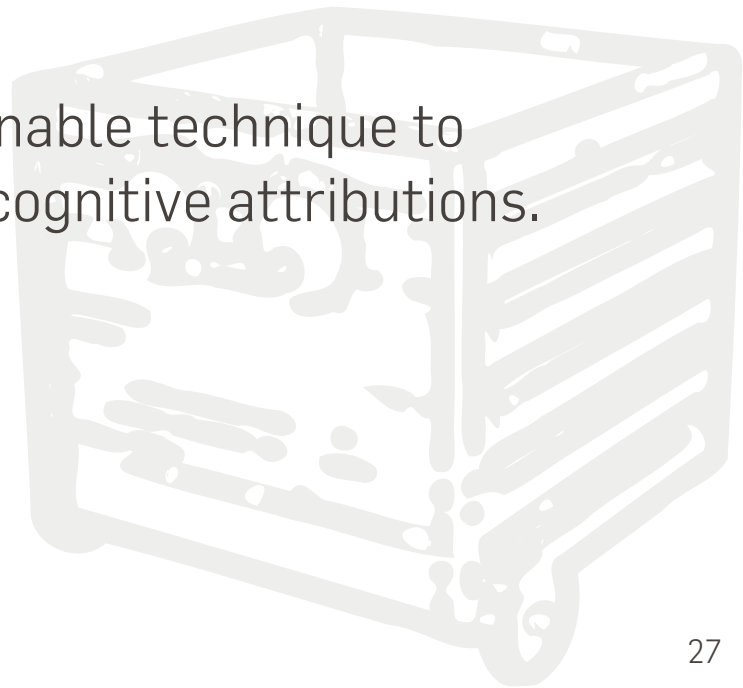
Children **do not seem to attribute much intentionality** to the robot, irrespective of the type of mis-behaviour (the robot "always obey"). Interestingly, the children did nonetheless ascribe perceptual cognitive capabilities (like seeing or hearing).

TAKE HOME MESSAGE(S)

REMINDER: OUR TWO HYPOTHESES

1. **A robot that mis-behaves from time to time is more engaging**
2. **The way the robot "mis-behaves" betrays its cognitive capabilities**

If that's indeed the case, we gain an actionable technique to (1) sustain engagement, (2) influence on cognitive attributions.



MIS-BEHAVIOURS AND COGNITIVE ASCRIPTION

Our design relies on the assumption of an **interplay between observed mis-behaviours and cognitive ascriptions by the user onto the robot**, namely:

Observation	**Interpretation**
mechanical malfunction (bugs)	more machine-like; less cognitive ascriptions
disobeying	explicit intentionality; more human-like; more cognitive ascriptions
error recovery	the robot is fallible, recognizes it, and recover; more human-like; more cognitive ascriptions

MIS-BEHAVIOURS AND COGNITIVE ASCRIPTION

Observation	Interpretation
mechanical malfunction (bugs)	more machine-like; less cognitive ascriptions
disobeying	explicit intentionality; more human-like; more cognitive ascriptions
error recovery	the robot is fallible, recognizes it, and recover; more human-like; more cognitive ascriptions

These conditions were not recognized by the children: too young? robot's behaviours ill designed? wrong measure?

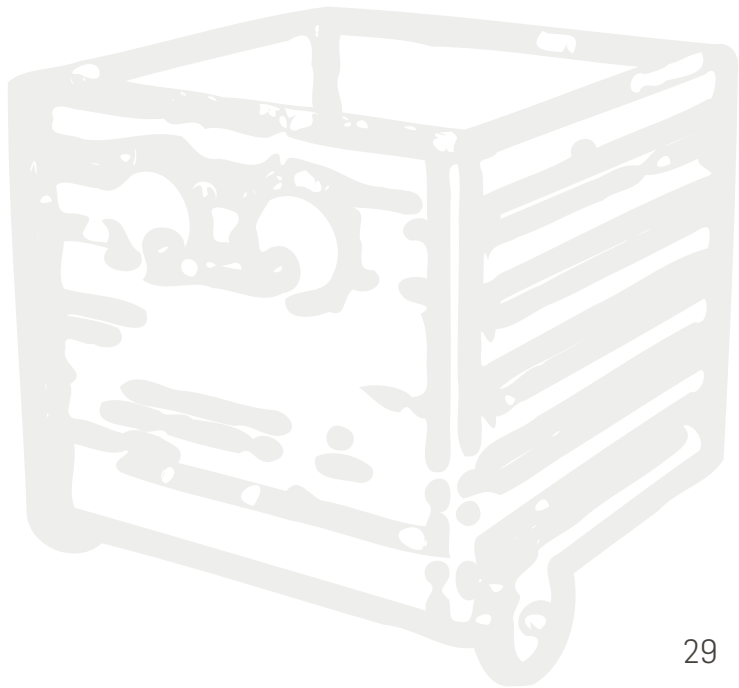
MIS-BEHAVIOURS AND COGNITIVE ASCRIPTION

Observation	**Interpretation**
mechanical malfunction (bugs)	more machine-like; less cognitive ascriptions
disobeying	explicit intentionality; more human-like; more cognitive ascriptions
error recovery	the robot is fallible, recognizes it, and recover; more human-like; more cognitive ascriptions

Nonetheless a design to explore!

BEHAVIOUR VS PERCEPTION?

Any relation between the behavioural and perceptual measurements?

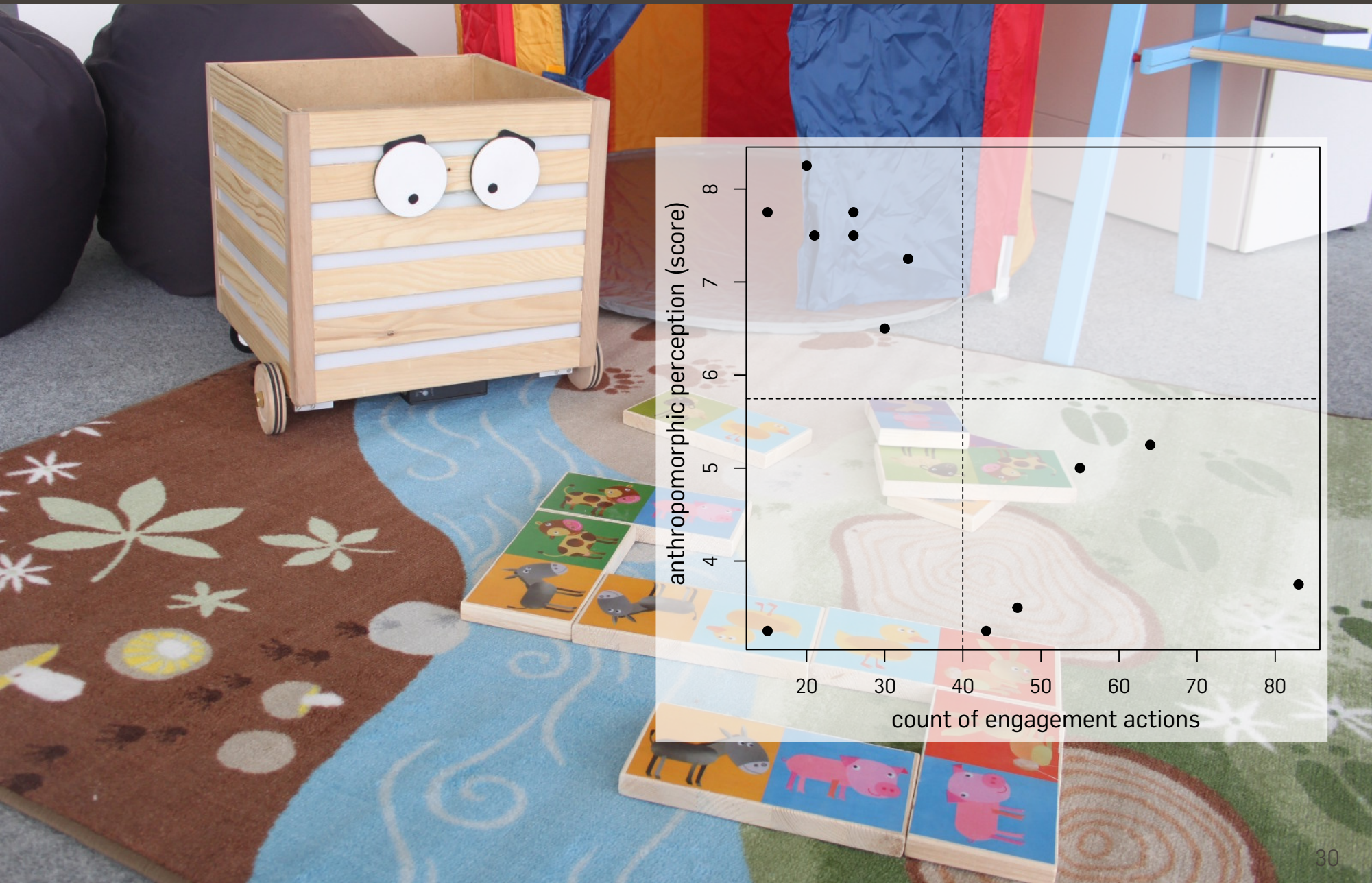


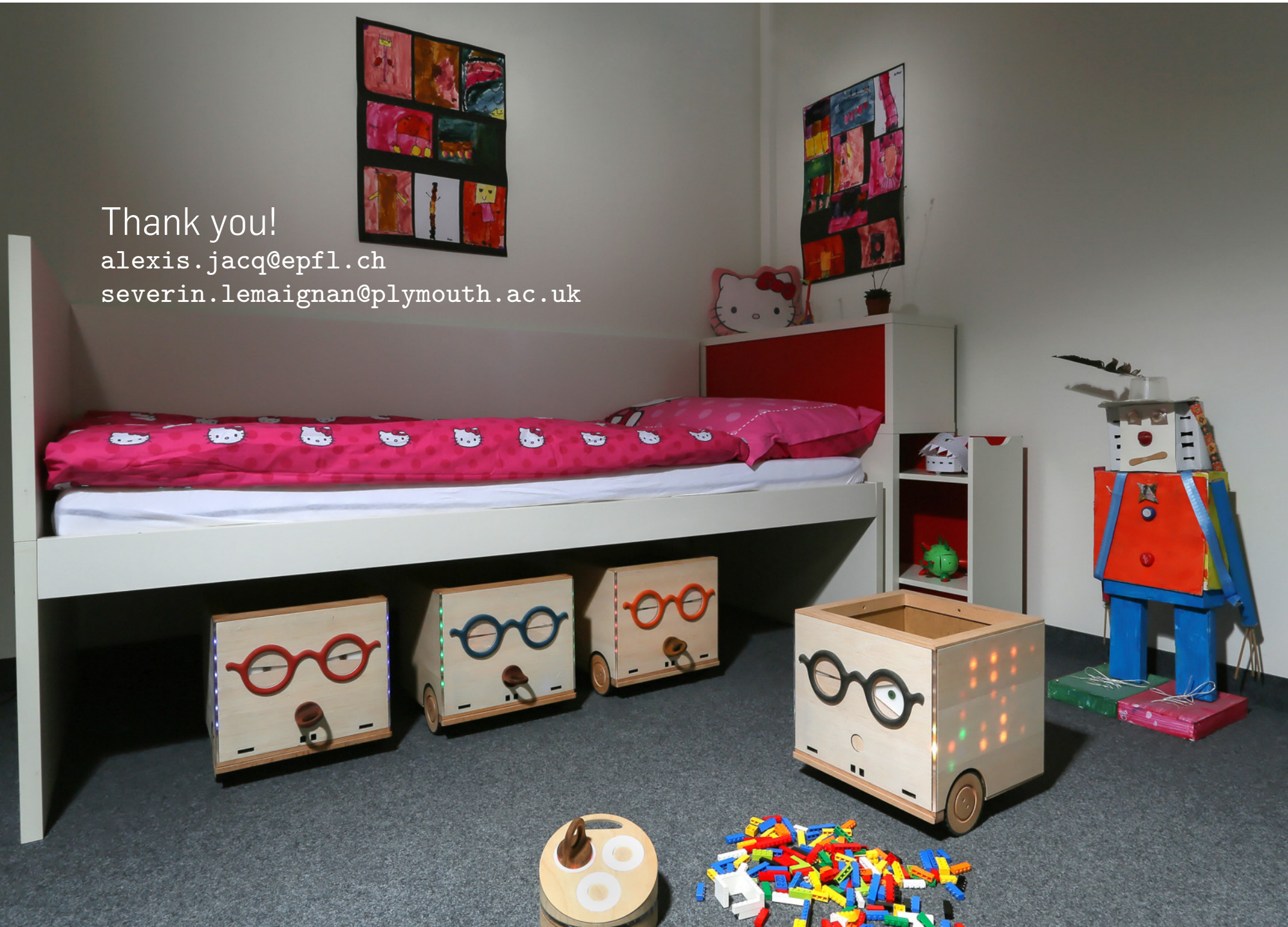
BEHAVIOUR VS PERCEPTION?

Any relation between the behavioural and perceptual measurements?

We can compute for each pair an “anthropomorphic perception” score based on the interviews (cf paper), and...

ANTHROPOMORPHISM != ENGAGEMENT




Thank you!
alexis.jacq@epfl.ch
severin.lemaignan@plymouth.ac.uk