Does Exposure to Technological Knowledge Modulate the Adoption of the Intentional Stance Towards Humanoid Robots in Children?

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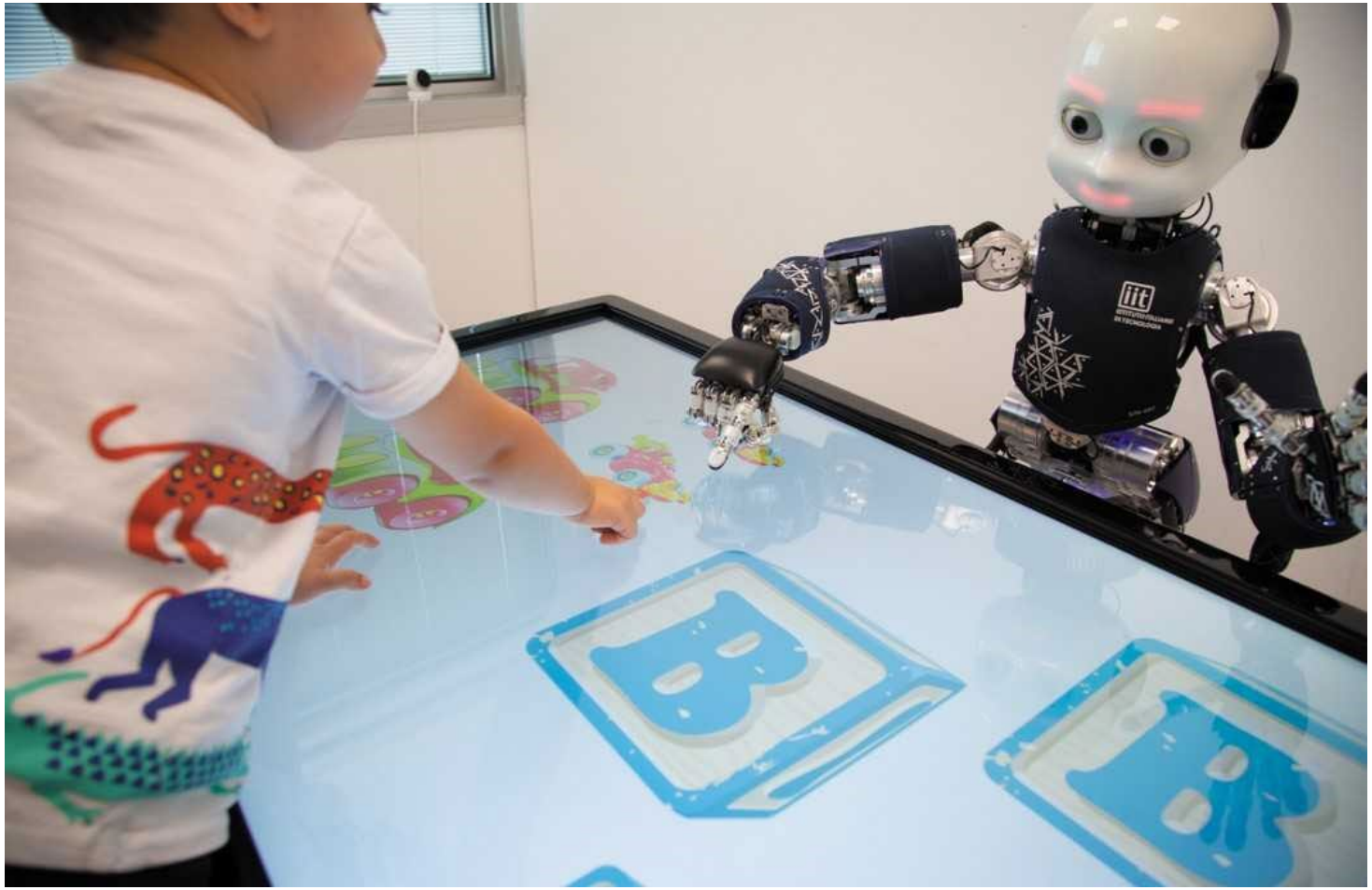
Humanoid Robots in Education with Children

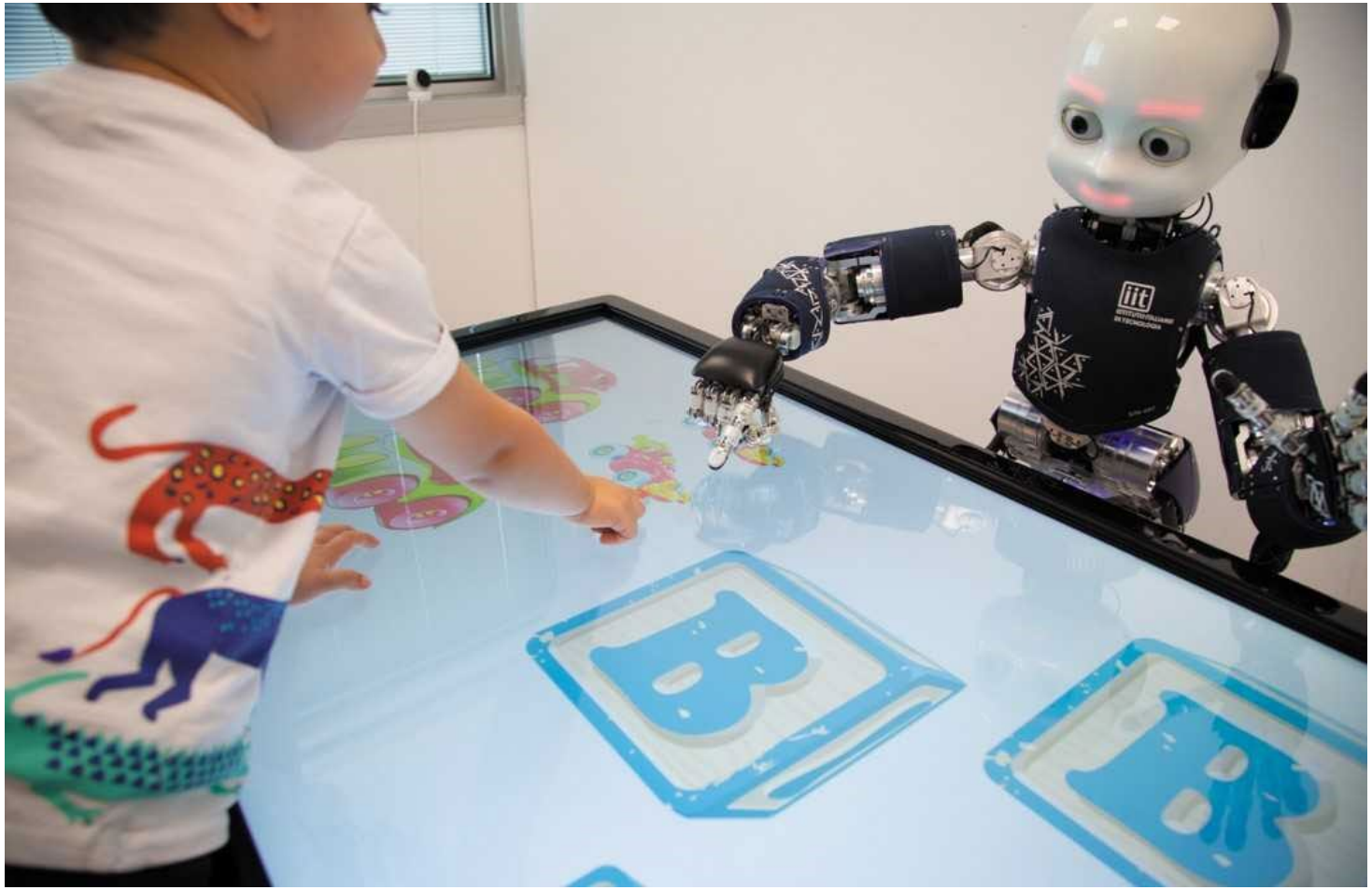


See Belpaeme, T., et. al., (2018) and Scassellati et al., (2012) for a review

Humanoid Robots in Education with Children

Teaching social skills to children with autism

- Not as complex as humans which can limit distress
- Can exhibit social gesture



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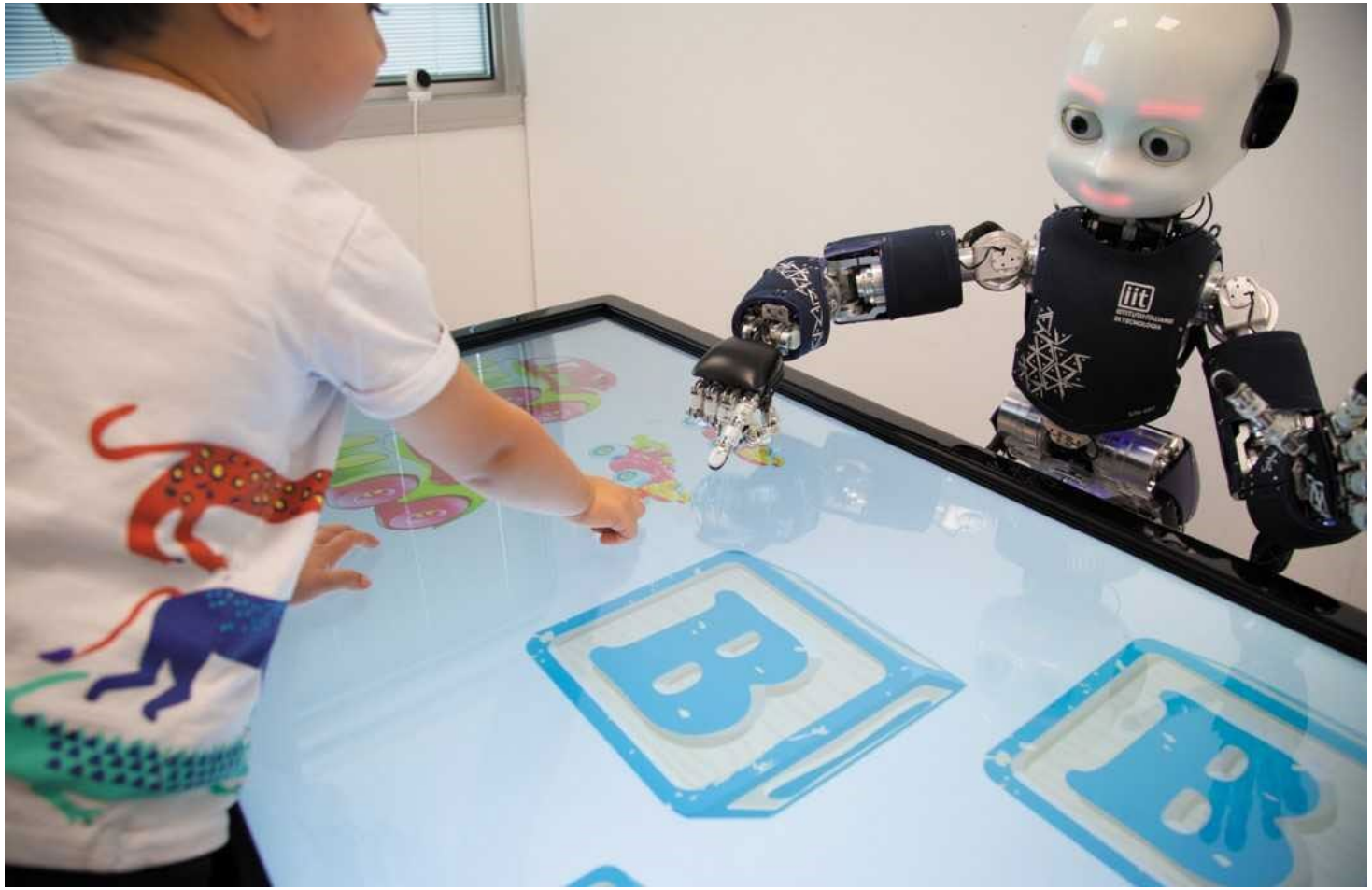
Humanoid Robots in Education with Children

Teaching social skills to children with autism

- Not as complex as humans which can limit distress
- Can exhibit social gesture

Teaching second languages

- Emphasis learning through actions and embodiment
- Reduce stress associated with a teacher



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Exposure & Social Perception of Robots

Kahn et al., (2004); Turkle (1998; 1999); Bernstein, D., & Crowley, K. (2008)

Exposure & Social Perception of Robots

- Exposure to robots might influence whether children categorise them as social agents

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- Children who had less experience with robots perceived them as having intelligence and psychological states

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Exposure & Social Perception of Robots

- Exposure to robots might influence whether children categorise them as social agents
- Children who had less experience with robots perceived them as having intelligence and psychological states
- Children with more experience thought robots might be intelligent, *but not* have psychological states

Kahn et al., (2004); Turkle (1998; 1999); Bernstein, D., & Crowley, K. (2008)

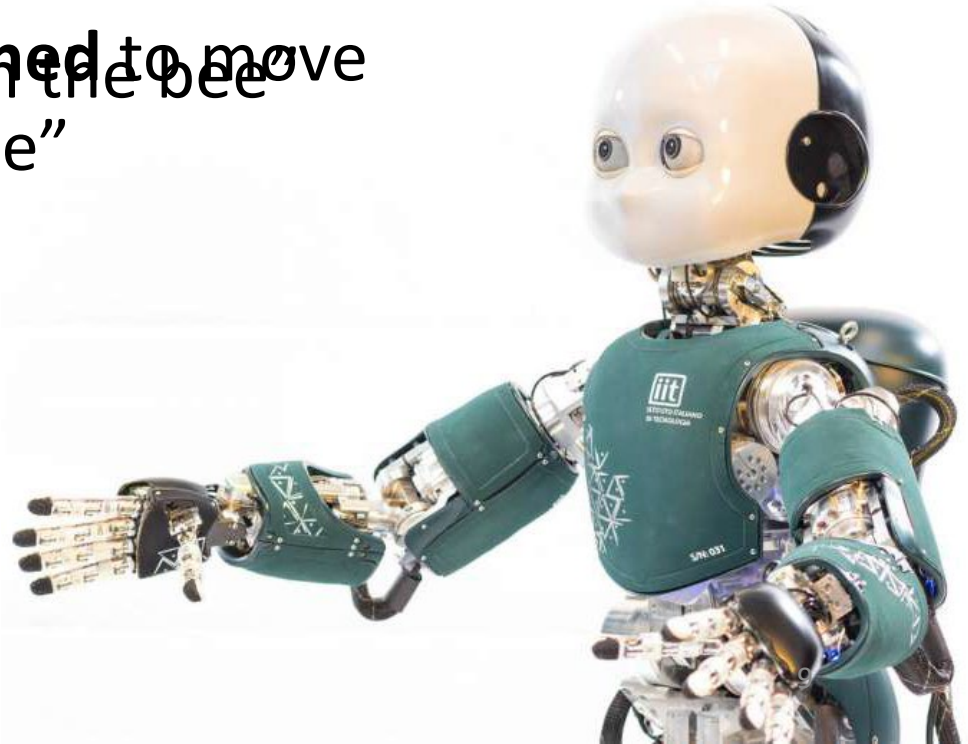
The Intentional Stance Framework

Intentional Stance: Attribution of mental states to others to understand and predict behaviour

Design Stance: Explaining behaviour with reference to functional design

"The robot was **programmed** to move its cameras toward the bee"

"The robot **wants to** catch the bee"



Dennett, D. C. (1971).

Our Study Aimed to…

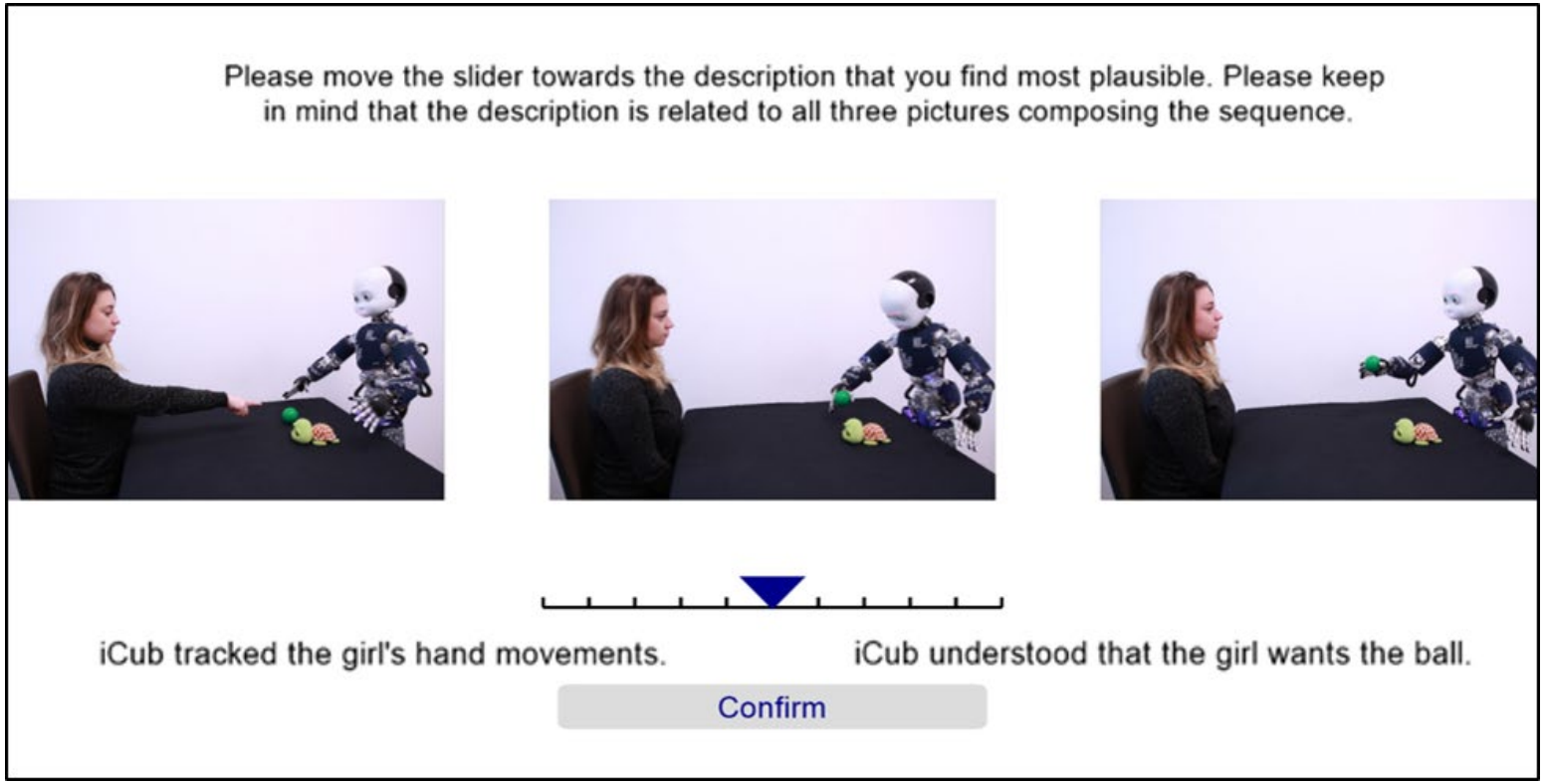
Investigate whether more exposure to technological knowledge modulates children's tendency to adopt the Intentional Stance towards a humanoid robot

Hypothesis

Attending the technology workshop will modulate the adoption of the Intentional Stance

Ghiglino & Wykowska, (2020); Heerink et al., (2011); Kahn et al., (2004); Turkle (1998, 1999); Bernstein & Crowley (2008)

Instance Test

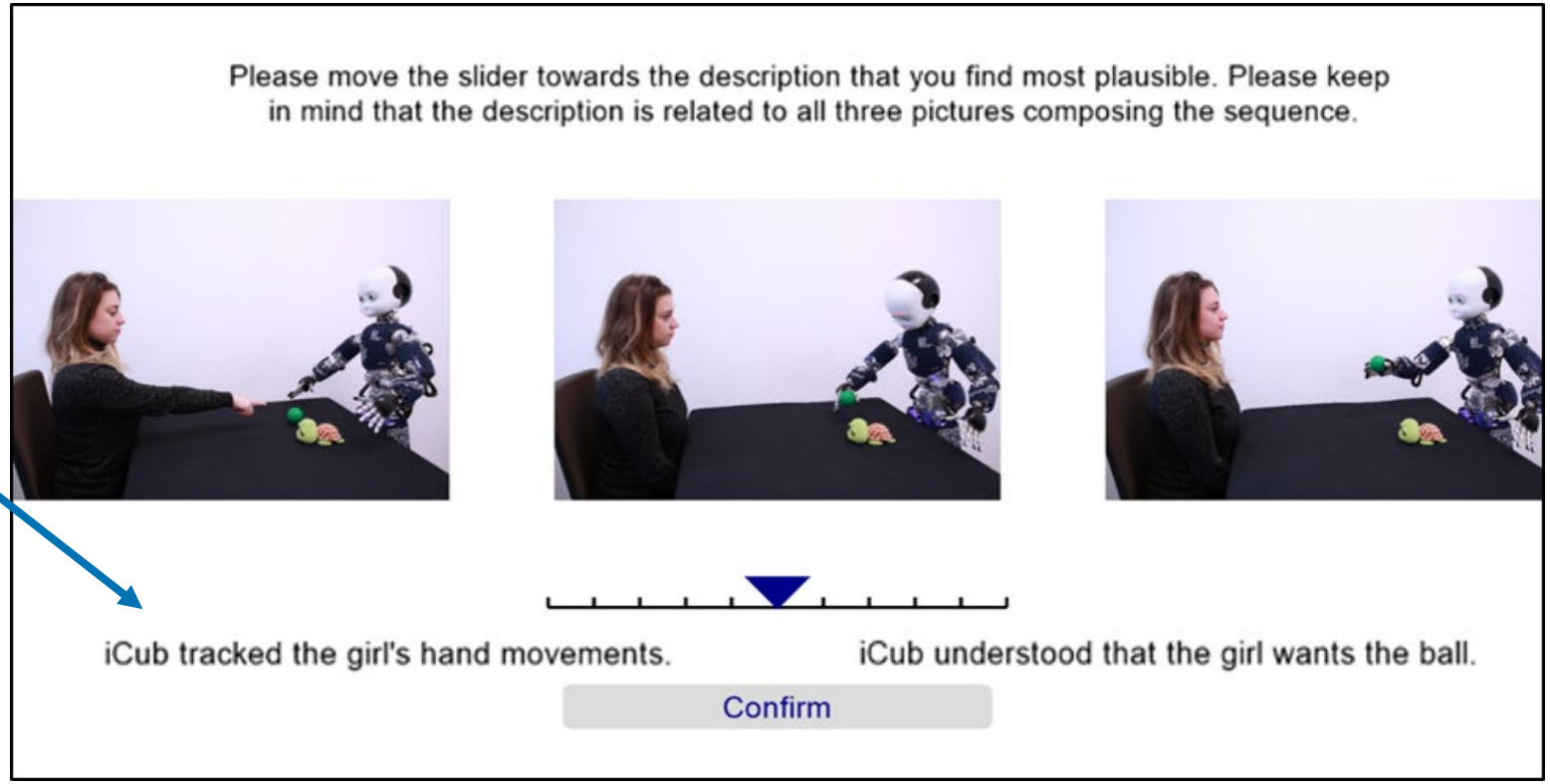


Items from the InStance Test

Spatola, Marchesi & Wykowska (2021); Marchesi et al., (2019)

Instance Test

Design Stance



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Instance Test

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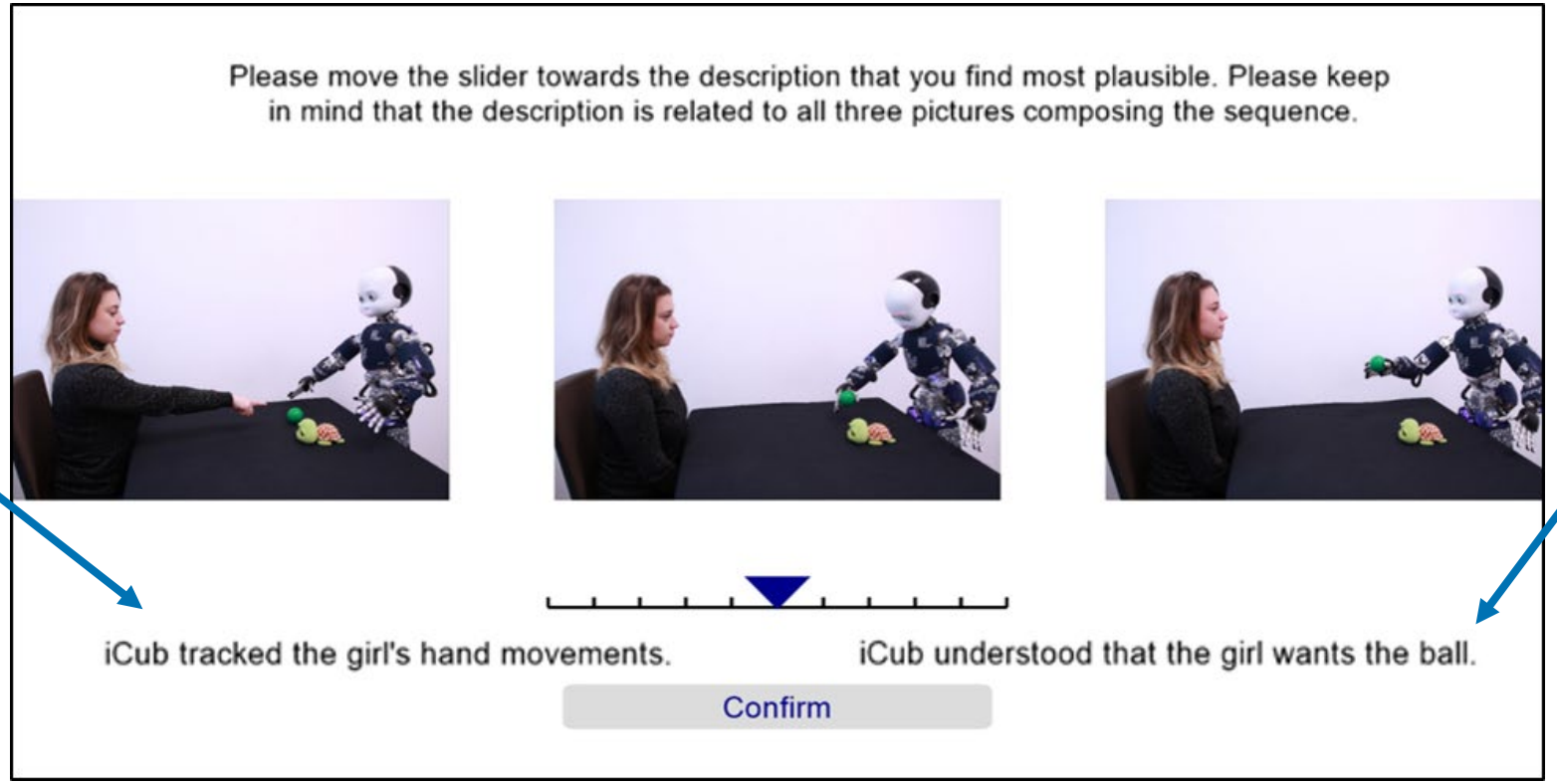

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Spatola, Marchesi & Wykowska (2021); Marchesi et al., (2019)

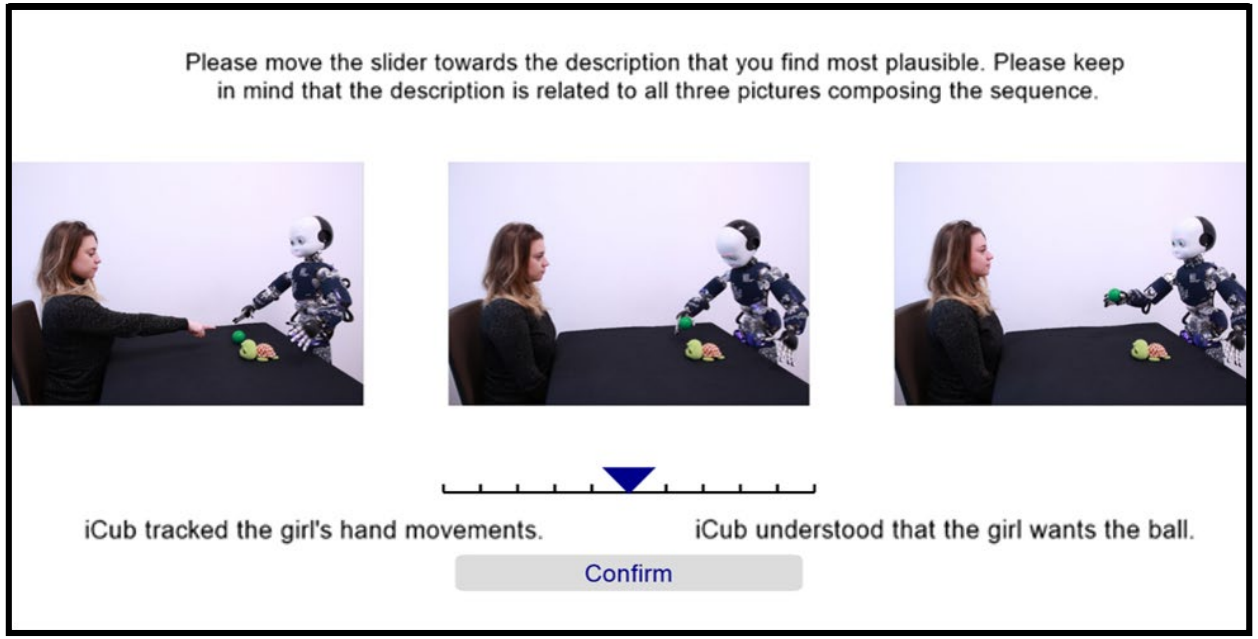
Design & Participants

Repeated Measures Design

Children aged between 10 – 11 years (Age_M = 10.81, Age_{SD} *SD* = 0.5) were recruited from the International School of Genova (*N* = 25)

Design

InStance Test Pre → Workshop → InStance Test Post → Vocabulary Comprehension



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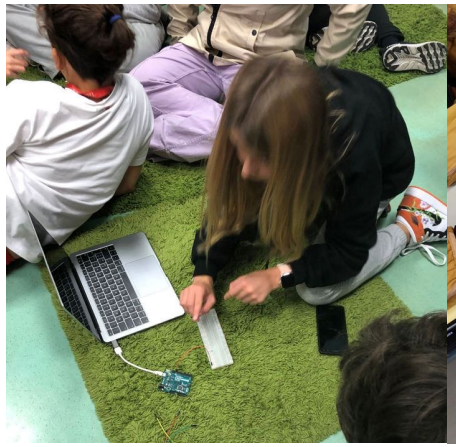
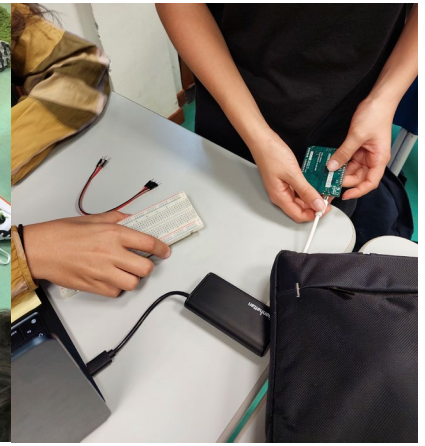
Design

InStance Test Pre → **Workshop** → InStance Test Post → Vocabulary Comprehension

Presentation

Practical Session





Demonstration

Design

InStance Test Pre → **Workshop** → InStance Test Post → Vocabulary Comprehension

Presentation

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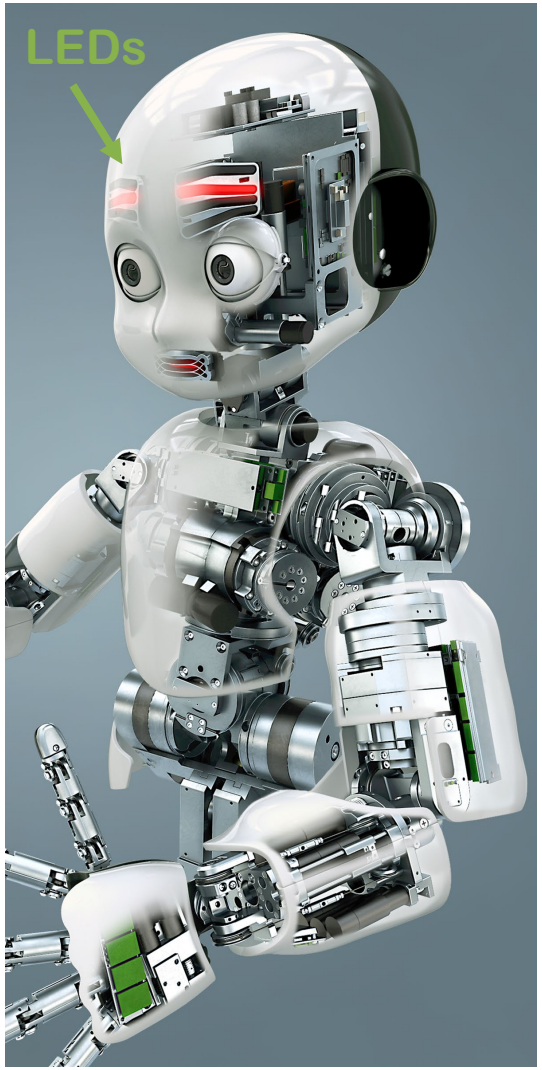
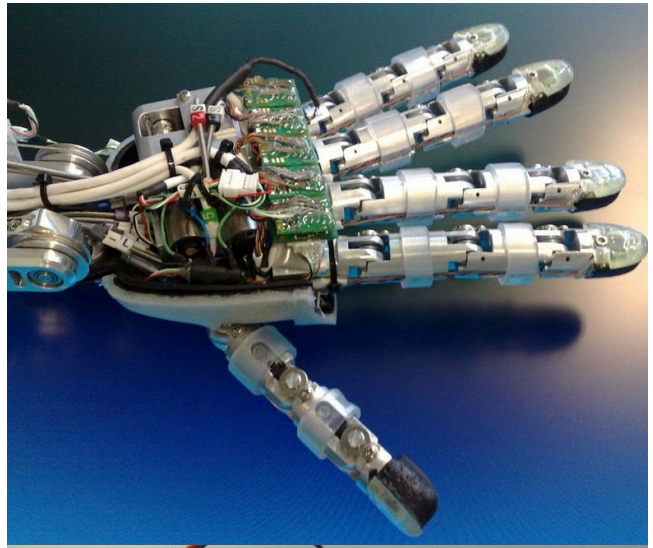
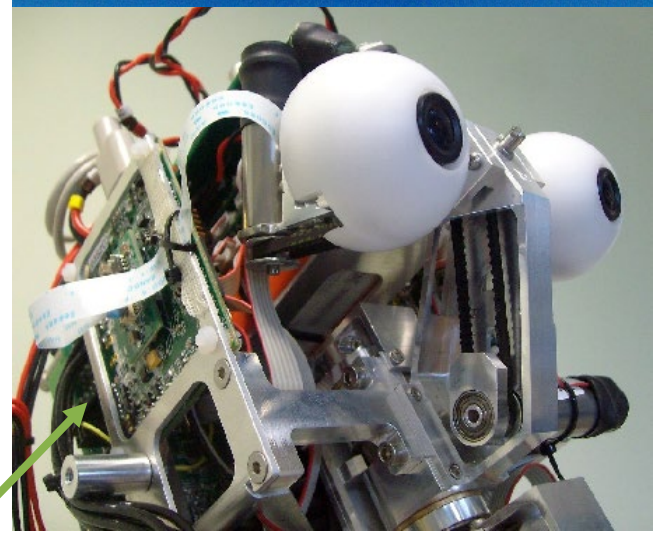


CODE

```
/*
 * SPDX-FileCopyrightText: 2006-2021 Istituto Italiano di Tecnologia (IIT)
 * SPDX-FileCopyrightText: 2006-2010 RobotCub Consortium
 * SPDX-License-Identifier: BSD-3-Clause
 */

#include <yarp/os/all.h>
#include <stdio.h>
using namespace yarp::os;

int main(int argc, char *argv[]) {

  // Set up YARP
  Network yarp;

  // Make two ports called /hello/in and /hello/out
  // We'll send "Bottles" (a simple nested list container) between these ports
  BufferedPort<Bottle> inPort, outPort;
  bool ok = inPort.open("/hello/in");
  ok = ok && outPort.open("/hello/out");
  if (!ok) {
    fprintf(stderr, "Failed to create ports.\n");
    fprintf(stderr, "Maybe you need to start a nameserver (run 'yarpserver')\n");
    return 1;
  }

  // Make a connection between the output port and the input port
  yarp.connect(outPort.getName(),inPort.getName());

  for (int i=0; i<10; i++) {

    // prepare a message to send
    Bottle&out = outPort.prepare();
    out.clear();
    out.addString("Hello");
    out.addInt32(i);
    printf("Sending %s\n", out.toString().c_str());

    // send the message
    outPort.write(true);

    // read the message
    Bottle *in = inPort.read();
    if (in==NULL) {
      fprintf(stderr, "Failed to read message\n");
      return 1;
    }
    printf("Received %s\n", in->toString().c_str());
  }

  return 0;
}
```

MOTORS





MINI-COMPUTERS

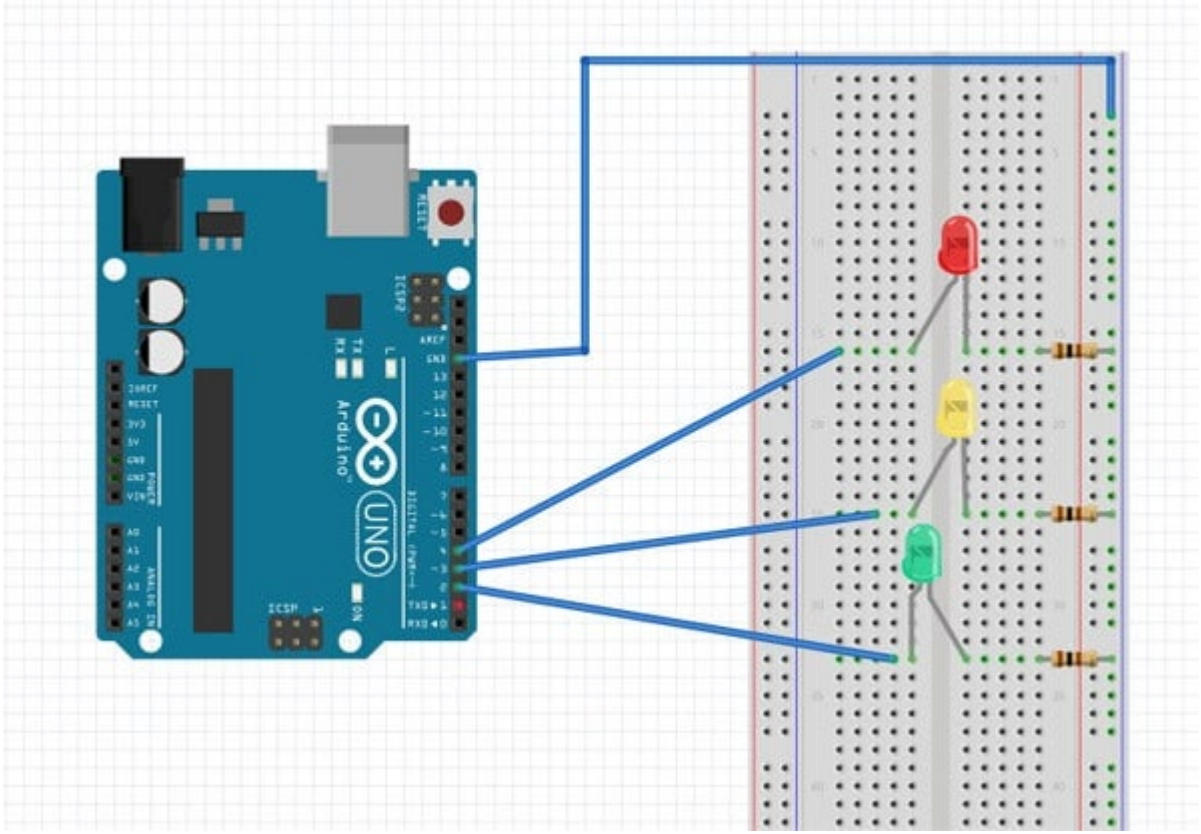
Design

InStance Test Pre → **Workshop** → InStance Test Post → Vocabulary Comprehension

Presentation

Practical Session

Demonstration



```
// variables
int GREEN = 2;
int YELLOW = 3;
int RED = 4;
int DELAY_GREEN = 5000;
int DELAY_YELLOW = 2000;
int DELAY_RED = 5000;


// basic functions
void setup()
{
  pinMode(GREEN, OUTPUT);
  pinMode(YELLOW, OUTPUT);
  pinMode(RED, OUTPUT);
}
```

https://create.arduino.cc/projecthub/techno_z/arduino-traffic-light-simulator-2ec9f7

Design

InStance Test Pre → **Workshop** → InStance Test Post → Vocabulary Comprehension

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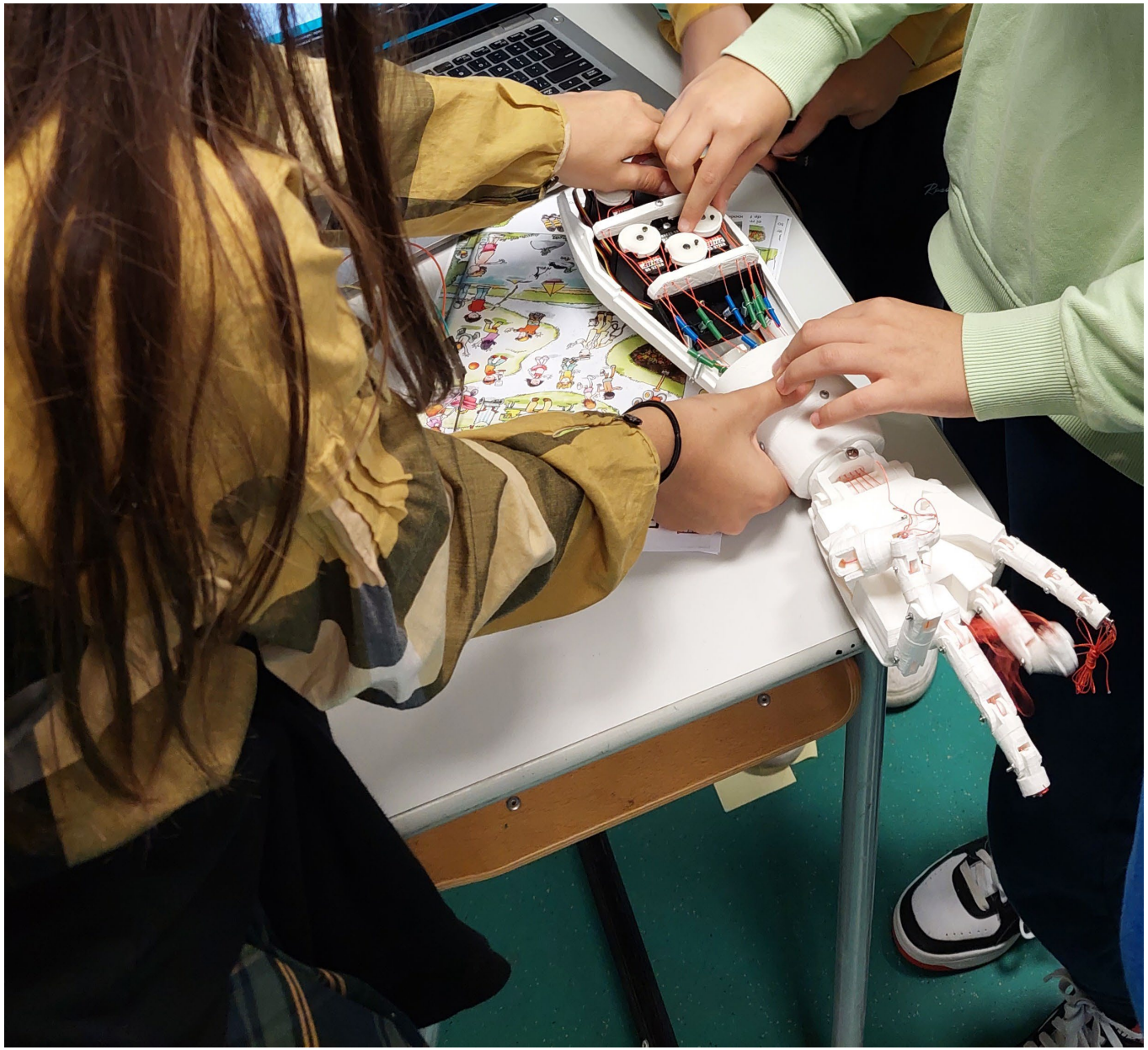

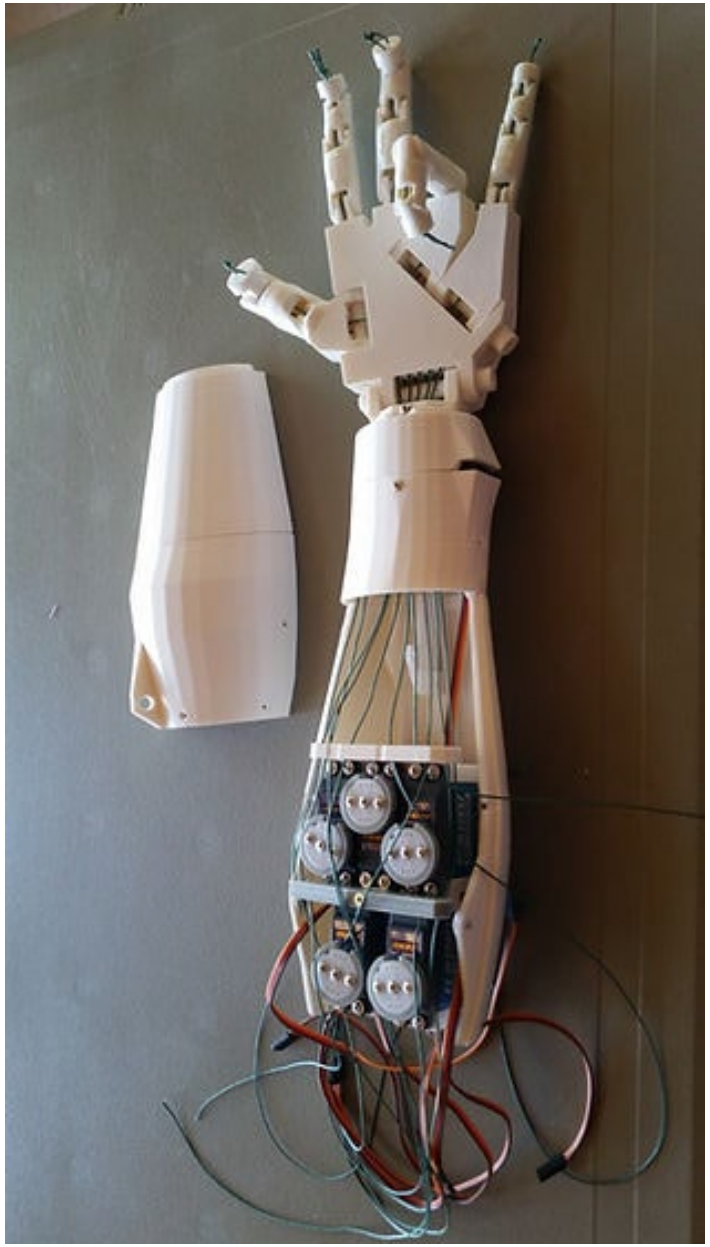

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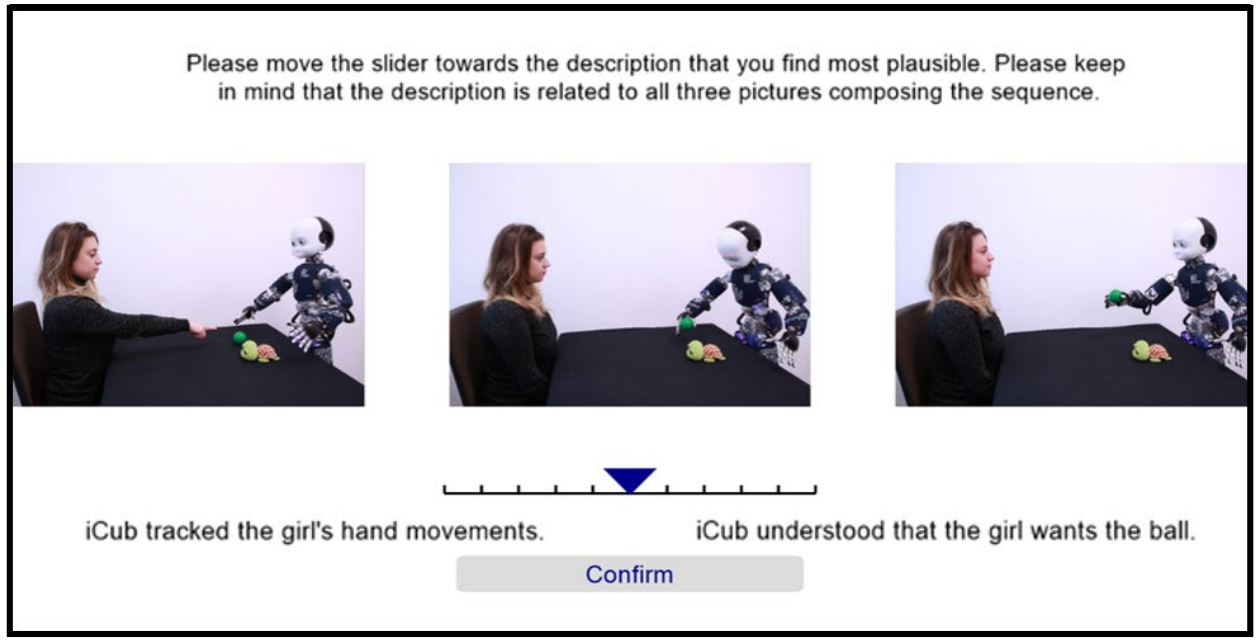
Design

InStance Test Pre → Workshop → **InStance Test Post** → Vocabulary Comprehension



Items from the InStance Test

Spatola, Marchesi & Wykowska (2021); Marchesi et al., (2019)

Design

InStance Test Pre → Workshop → InStance Test Post → **Vocabulary Comprehension**

What is the correct definition of the word "**tracker**?"

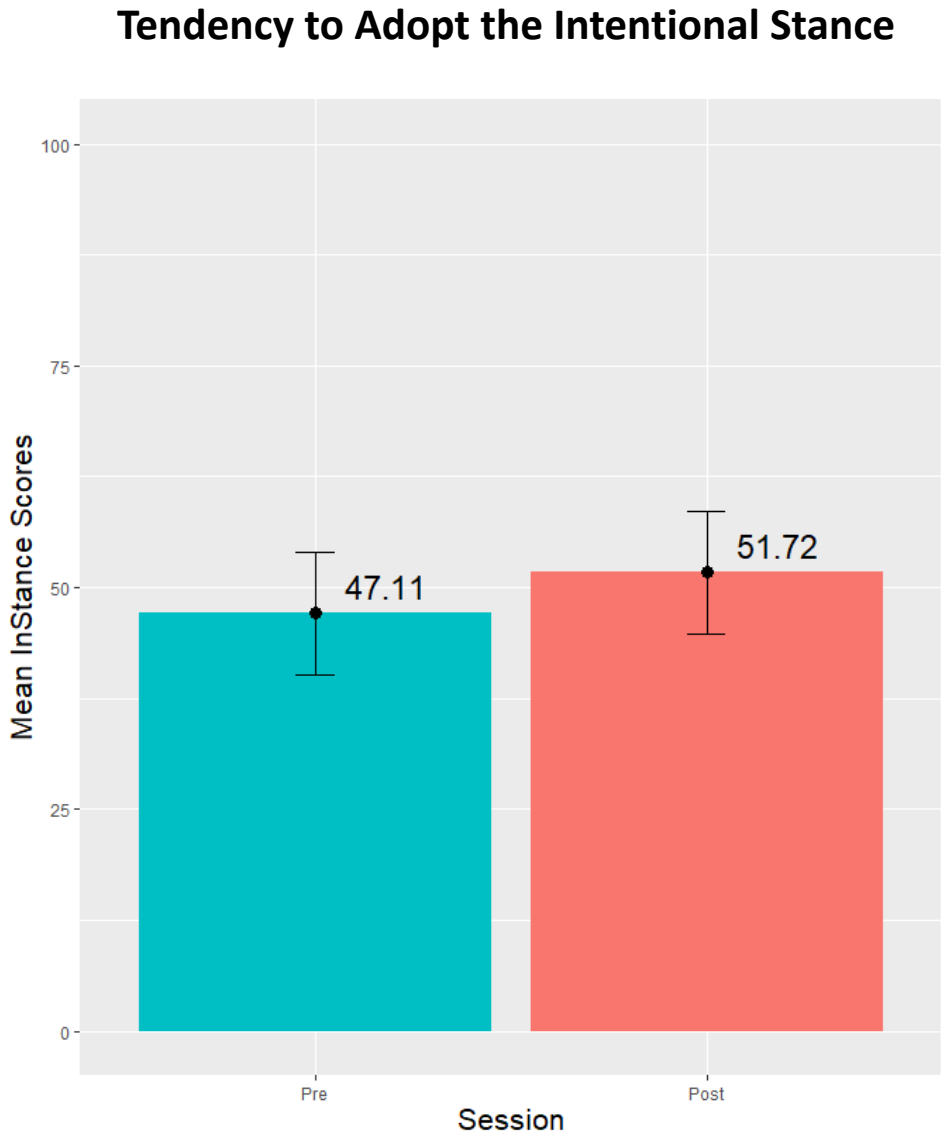
a. car with a driver whom you pay to take you where you want to go
b. a device that shows where someone or something is
c. an area, often covered with sand or rocks, where there is very little rain and not many plants

Results

Demographics

Age *M(SD)*	Female	Male	*N*
10.87(.33)	6	10	16

No difference between the pre and post [$t(15) = -1.451$, $p = .167$, $d = .170$ ($M_{pre} = 47.11$, $SD_{pre} = 42.53$, $M_{post} = 51.72$, $SD_{post} = 41.69$,)].



Conclusion

- Exposure two hour workshop might not be sufficient to modulate adoption of the intentional stance
- Expertise results from a large accumulation of knowledge
- Expertise effects whether individuals represent knowledge locally or globally
- Therefore children might not have been able to develop expertise in technology and might have had difficulty generalizing their knowledge from the local components to the global humanoid robot

Chi (1978); Hmelo-Silver & Pfeffer (2004); Johnson & Mervis (1994)

Limitations

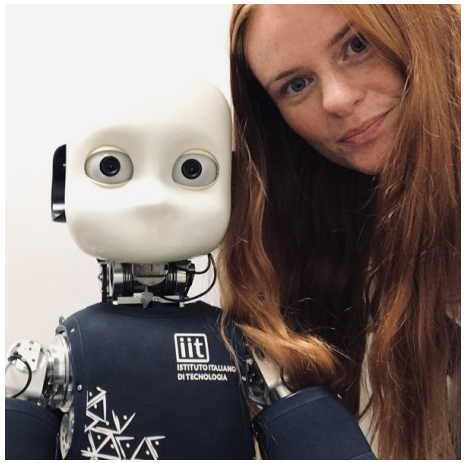
- Small sample size
- Short workshop duration
- InStance Test vocabulary

Take home message…

Children might require more extended exposure to technological knowledge to modulate the adoption of the Intentional Stance

Intentional Stance for Social Attunement

Prof. Agnieszka Wykowska
Principle Investigator



Ziggy O'Reilly
PhD Student

Cecilia Roselli
Post-doctorate

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Acknowledgements

We would like to thank Christina Koprowicz from the International School in Genova for her dedication to promoting science education, assistance with recruitment, class-room organization and technological support.