Experiment: Does embodiment affect tutoring behavior?

K. S. Lohan, S. Gieselmann, A. Vollmer, K. Rohlfing and B. Wrede

Experiment:
the simulated robot Akachan and the iCub robot in two conditions (NoHead & Head) are chosen as learner to explore the difference in tutoring behavior.

Setup:
of the robot-directed interaction
Task: Stacking Cups (Becher)
Group: 14 participants (9 female and 5 male)

Setup:
of the stimulated robot-directed interaction
Task: Stacking Cups (Becher)
Group: 14 participants (9 female and 5 male)
also in the iCub Experiment.
Annotation & Results

Eye-gaze

Cup transport

Action

stacking-cups action

Gaze to object  Gaze to partner  Gaze elsewhere

Core Lab
Annotation & Results
Concerning our findings in the Head condition, *iCub was gazed at longer and the number of gaze shifts towards the object was higher in this condition.*
Concerning our findings in the Head condition, *iCub* was gazed at longer and the number of gaze shifts towards the object was higher in this condition. In the Akachan condition, we found that during the task, the tutor was looking longer towards the object than in the Head condition.

### TABLE: Akachan vs iCubHead

<table>
<thead>
<tr>
<th>variable</th>
<th>M</th>
<th>SD</th>
<th>t(5)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency of eye-gaze bouts to object</td>
<td>5.61</td>
<td>2.23</td>
<td>2.51</td>
<td>0.054</td>
</tr>
<tr>
<td>average length of eye-gaze bout to object</td>
<td>-1.69</td>
<td>1.03</td>
<td>-3.998</td>
<td>0.010</td>
</tr>
<tr>
<td>total length of eye-gaze bout to interaction partner</td>
<td>2.27</td>
<td>8.62</td>
<td>2.63</td>
<td>0.046</td>
</tr>
<tr>
<td>total length of eye-gaze bouts to object</td>
<td>-2.41</td>
<td>8.14</td>
<td>-2.961</td>
<td>0.031</td>
</tr>
</tbody>
</table>

**TABLE II**

For all measures we calculated a student *T*-test. Equating the Akachan vs. Head we used a paired student *T*-test. Because of the design, it was not possible to calculate a ANOVA. All variables were normally distributed.
Concerning our findings in the Head condition, *iCub was gazed at longer and the number of gaze shifts towards the object was higher in this condition*. In the Akachan condition, we found that during the task, the tutor was looking longer towards the object than in the Head condition. The data indicate that there is an increase of tutor’s monitoring behavior in the Head condition, because there was more "checking" towards the *iCub*. 

**TABLE: Akachan vs iCubHead**

<table>
<thead>
<tr>
<th>variable</th>
<th>M</th>
<th>SD</th>
<th>t(5)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency of eye-gaze bouts to object</td>
<td>5.61</td>
<td>2.23</td>
<td>2.51</td>
<td>0.054</td>
</tr>
<tr>
<td>average length of eye-gaze bout to object</td>
<td>-1.69</td>
<td>1.03</td>
<td>-3.998</td>
<td>0.010</td>
</tr>
<tr>
<td>total length of eye-gaze bout to interaction partner</td>
<td>2.27</td>
<td>8.62</td>
<td>2.63</td>
<td>0.046</td>
</tr>
<tr>
<td>total length of eye-gaze bouts to object</td>
<td>-2.41</td>
<td>8.14</td>
<td>-2.961</td>
<td>0.031</td>
</tr>
</tbody>
</table>

**TABLE II**

For all measures we calculated a student *T*-test. Equating the Akachan vs. Head we used a paired student *T*-test. Because of the design, it was not possible to calculate a ANOVA. All variables were normally distributed.
Cooperations study with Denmark based on previous study

Experiment with the iCub robot in four conditions to explore the difference in tutoring behavior.

<table>
<thead>
<tr>
<th>Saliency based Gazing Behaviour</th>
<th>iCub only eyes moving</th>
<th>iCub head and eyes following the salient point, Background Behavior movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Gazing Behaviour</td>
<td>iCub only eyes moving</td>
<td>iCub head and eyes following a random point, Background Behavior movement</td>
</tr>
</tbody>
</table>

iCub Experiment of a robot-directed interaction
6 Tasks
47 participants
Developing Feedback: How Children of Different Age Contribute to a Tutoring Interaction with Adults

A. Vollmer, K. Pitsch, K. S. Lohan, J. Fritsch, K. Rohlfing, B. Wrede

Bielefeld Motionese Corpus
Task: Stacking Cups (Becher)

Target:
Investigate the feedback provided by children of different age groups

Hypothesis:
Infants produce different kinds of feedback which display their current understanding of the demonstrated action according to their age and different levels of (cognitive, verbal, and motoric) development.
Basic version of action presentation:
· marking the beginning
· three movements of transporting the cups separated by short pauses
· marking the end of the action

For action demonstration, parents use:
Verbal language
Body movements (gestures, gaze, facial expressions, object manipulation)
the infant’s timing of its own (verbal and bodily) action in relation to the parent’s demonstration seems highly systematic.

Feedback operates on two levels
1) continuous involvement
2) at specific places within the structure of the interaction
There are small differences between age groups:

Pre-lexical infants:
- Gazing behavior displaying the infant’s state of attention.

Early lexical infants:
- Anticipating next actions with the direction of gaze
- More gestures and other modalities give information about the understanding of the presented action
  - “look”/“guck mal” - infant gaze: attention getter -> structuring signal

Lexical infants:
- Systematic feedback according to the structure of the action including instructions for the tutor’s next actions