Non-verbal Interaction

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Non-verbal Interaction and Communication

- Types or methods?
- Purpose?

Effects of Nonverbal Communication on Efficiency and Robustness in Human-Robot Teamwork

Cynthia Breazeal, Cory D. Kidd, Andrea Lockerd Thomaz, Guy Hoffman, Matt Berlin

Non-verbal Communication Types

- Explicit
- Implicit

The Goals

- Transparency and understandability of the robot’s internal state
- Efficiency of task performance
- Robustness to errors

The Experiment

- Human
- Lea
- Three colored buttons
The Experiment

- Teach Leo the names and locations of the buttons
- Check to see that the robot knows them
- Have Leo turn on all of the buttons
- Tell Leo that the “all the buttons on task” is done

The Hypotheses

- From the questionnaire:
  - H1: Subjects are better able to understand the robot’s current state and abilities in the IMP+EXP case.
  - H2: Subjects have a better mental model of the robot in the IMP+EXP case.
  - H3: The interaction is viewed as more effective from the subject’s point of view in the IMP+EXP case.

- From the video:
  - H4: The total length of the interaction will be shorter in the IMP+EXP case.
  - H5: Errors will be more quickly detected in the IMP+EXP case.
  - H6: The occurrence of errors will be better mitigated in the IMP+EXP case.

The Results

- H1: Subjects are better able to understand the robot’s current state and abilities in the IMP+EXP case.
- H2: Subjects have a better mental model of the robot in the IMP+EXP case.
- H3: The interaction is viewed as more effective from the subject’s point of view in the IMP+EXP case.
The Results

<table>
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<tr>
<th>Conditions</th>
<th>Category</th>
<th>Errors</th>
<th>Avg Task Time (s)</th>
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<td>A &lt; 1</td>
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<tr>
<td></td>
<td>B &lt; 4</td>
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<td></td>
<td>C &lt; 4</td>
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<td>C &gt; 4</td>
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The Conclusions

- Gaze
- Gaze
- Gaze

The Discussion

- What did we like?
- What did we dislike?
- What have we learned?
- How can we apply this to other problems?

Gaze-communicative Behavior of Stuffed-toy Robot with Joint Attention and Eye Contact based on Ambient Gaze-tracking

Tomoko Yonezawa, Hirotake Yamazoe, Akira Utsumi, Shinji Abe

The Goals

- A gaze-communicative stuffed-toy robot system with joint attention and eye-contact reactions based on ambient gaze-tracking
- Gradually establish:
  - Joint attention using the direction of the robot's head
  - Eye-contact reactions from several sets of motion

The Goals

Figure 8: Examples of Interaction
The Experiment

Gaze Tracking

The Hypotheses - Interest by Joint Attention

- Subjects can guess the “interest” of the stuffed-toy robot in either of two animations.
- The “interest” of the subjects is affected by the robot’s gaze.
- Subjects gaze longer at an animation that is also gazed at by the robot longer than at the other animation.

The Results

The Hypotheses - Effect of Reaction to Eye Contact

- Subjects guess that the stuffed-toy robot has a “favorable feeling” for the subjects from its eye-contact behavior.
- Subjects develop a “favorable feeling” for the robot by the eye-contact behavior.

The Results
The Hypotheses - Effect of User-initiative Joint Attention

- Subjects guess a “favorable feeling” of the stuffed-toy robot for the subjects from its behavior of joint attention.
- Subjects develop a “favorable feeling” for the robot by the joint attention.

The Hypotheses - Combined Effects

- The robot’s eye-contact reaction affects the subject’s guessed “favorable feeling” of the robot when it is used in combination with joint attention behavior.
- The eye contact affects the subject’s “favorable feeling” for the robot in combination with joint attention.
- The joint attention affects the subject’s guessed “favorable feeling” of the robot when it is used in combination with eye-contact reaction.
- The joint attention affects the subject’s “favorable feeling” for the robot in combination with eye contact.

The Results

Table 6: Analyses of Favorable Feeling #3

The Conclusions

- Subjects can determine a robot’s interest
- Subjects’ interest is not influenced by the robot’s gaze
- Subjects’ behaviors can be influenced by the robots behavior
- Eye contact reaction provides a more “favorable” setting
- “Favorable feelings” are enhanced with joint attention

The Discussion

- What did we like?
- What did we dislike?
- What have we learned?
- How can we apply this to other problems?