Enhancing Team Performance through Effective Communication

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Outline

- Effects of communication in teams
- Setup of the BW4T simulation experiment
- Results
  - Communication and team performance
  - Sharedness of mental models and team performance
- Discussion
Effects of communication in teams

- **Sharedness of mental models**

  more communication $\rightarrow$ higher sharedness $\rightarrow$ increased team performance

- **Cognitive load**

  more communication $\rightarrow$ higher cognitive load $\rightarrow$ information overload $\rightarrow$ decreased team performance
Shared mental models

- **Mental model:** people's internal representation of the world around them, that helps them to understand, explain and predict systems in the environment.

- **Shared mental model:** mental model shared by the members of a team, which can help individual team members to understand and predict the behavior of the other team members so that they can anticipate their own actions to the expected behavior of others.
Measuring sharedness of mental models

Set of questions $Q (q_1, q_2, ..., q_n)$
Set of mental models $M (m_1, m_2, ..., m_n)$

- Sharedness on a question $q$ is number of equal answers of all models in $M$ divided by total number of answers
- Sharedness with respect to a set of questions $Q$ is the average sharedness values of all questions
Setup of the BW4T simulation experiment

- Team goal: deliver all blocks of the goal sequence in the right order in the dropzone

- Agents can move around, and pickup, carry and drop blocks

- Agents can only see blocks when they are inside a room

- Agents cannot see each other
Agent teams

The agents were implemented in GOAL. They were all able to solve the BW4T task and only differed with respect to their communication behavior.

- Team A: no communication
- Team B: communication about world knowledge ("there is a red block in room B3")
- Team C: communication about intentions ("I am going to deliver the yellow block in room C1")
- Team D: communication about world knowledge
Scenarios: medium and high
Simulation runs

- 8 runs
  - 4 teams (A, B, C and D)
  - 2 scenarios (medium and high)

- Measures
  - Performance (time to complete task)
  - Communication (amount of sent messages)
  - Sharedness (logs of beliefs and goals at each block delivery)
### Sharedness of mental models: set of questions

<table>
<thead>
<tr>
<th>Component</th>
<th>Subcomponent</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>world knowledge</td>
<td>allBlocksAt(Room, [BlockIds])</td>
<td>the list of block-ids in a particular room</td>
</tr>
<tr>
<td></td>
<td>block(BlockId)</td>
<td>the id of an observed block</td>
</tr>
<tr>
<td></td>
<td>color(BlockId,Color)</td>
<td>the color of a particular block</td>
</tr>
<tr>
<td></td>
<td>gone(BlockId)</td>
<td>a particular block that was picked-up</td>
</tr>
<tr>
<td></td>
<td>holding(BlockId)</td>
<td>a block that is being held by a player</td>
</tr>
<tr>
<td></td>
<td>in(Player,Place)</td>
<td>the location of a particular player</td>
</tr>
<tr>
<td></td>
<td>at(BlockId,Room)</td>
<td>the room where a particular block is</td>
</tr>
<tr>
<td>knowledge about intentions</td>
<td>imp(Player, Goal)</td>
<td>the intention of a player to reach a particular goal</td>
</tr>
</tbody>
</table>
Results: time to achieve task
Results: communication
Results: performance and communication
Overall sharedness at each block delivery
Sharedness per component (av. block 1-5)
Conclusions and future work

- Conclusions
  - Sharedness of intentions contributes more to team performance than sharedness of world knowledge
  - Communication of intentions involves less messages than communication of beliefs

- Future work
  - Same results when humans in the loop?
  - How to determine set of relevant questions?
  - Other domains?