

Studying the Co-Construction of Interaction Protocols in Collaborative Tasks with Humans

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Aim: Flexible communication between humans and robots

Robots need to

- understand unknown signals
- make sense of what they refer to
- agree with the partner on how to organize the interaction into roles and turns



First step: Investigate how humans align and create common ground.

Aim: Flexible communication between humans and robots

Designing a new experimental setup

similar to Human-Robot interaction

- asymmetric: humans and robots do not have the same perceptual capabilities
- no shared interaction protocol
- humans might not know if and how exactly their signals are perceived by the robot



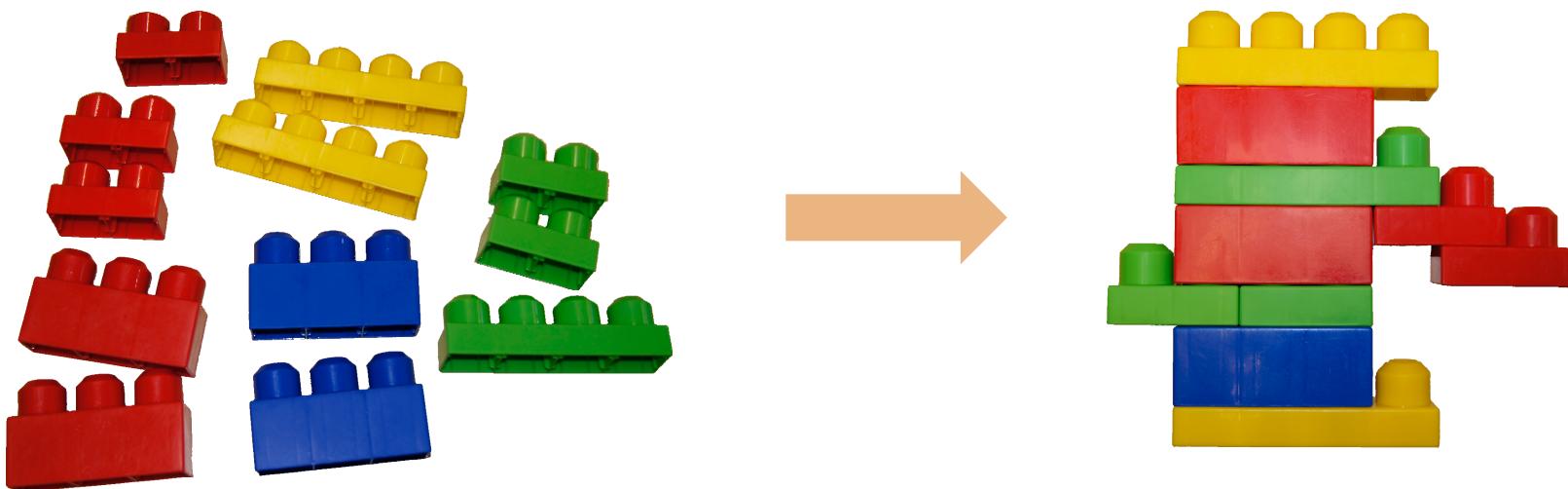
The Co-co Game

Two players

- joint construction task
- asymmetric roles
- restricted communication channels

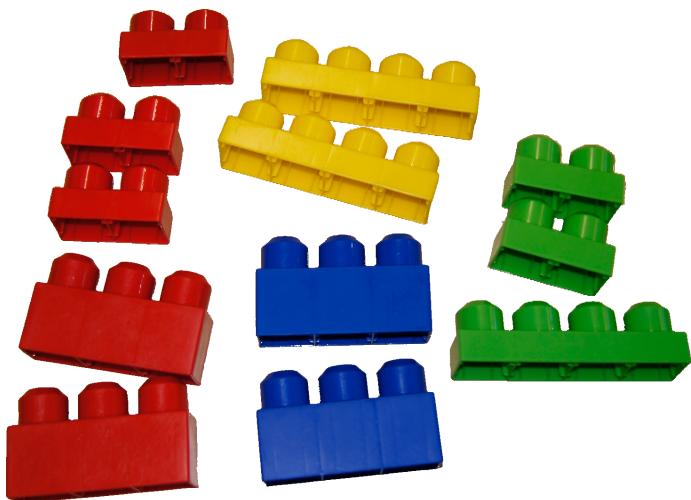
The Co-co Game

joint construction task

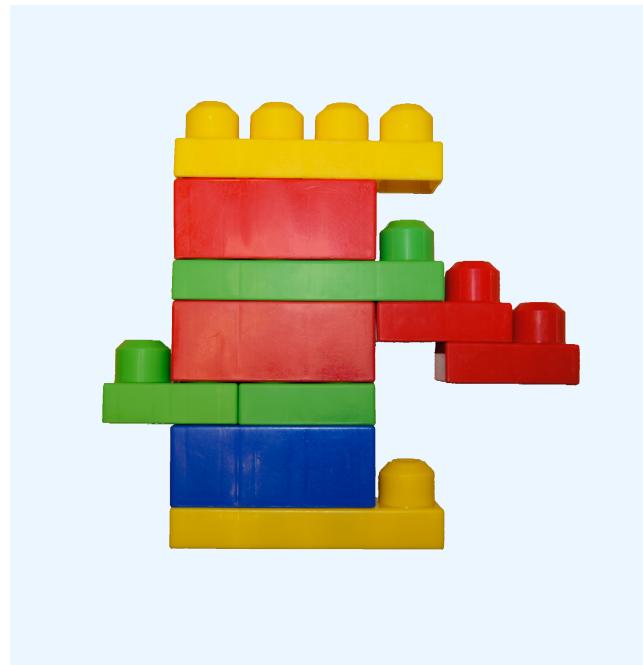


The Co-co Game

asymmetric roles: builder and architect



builder



architect

The Co-co Game

restricted communication channels



builder

architect

The Co-co Game

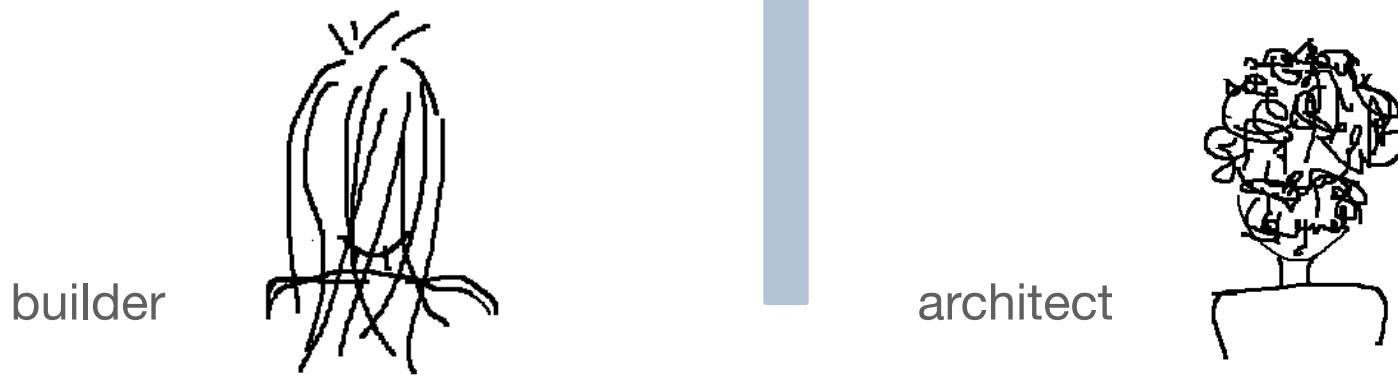
restricted communication channels



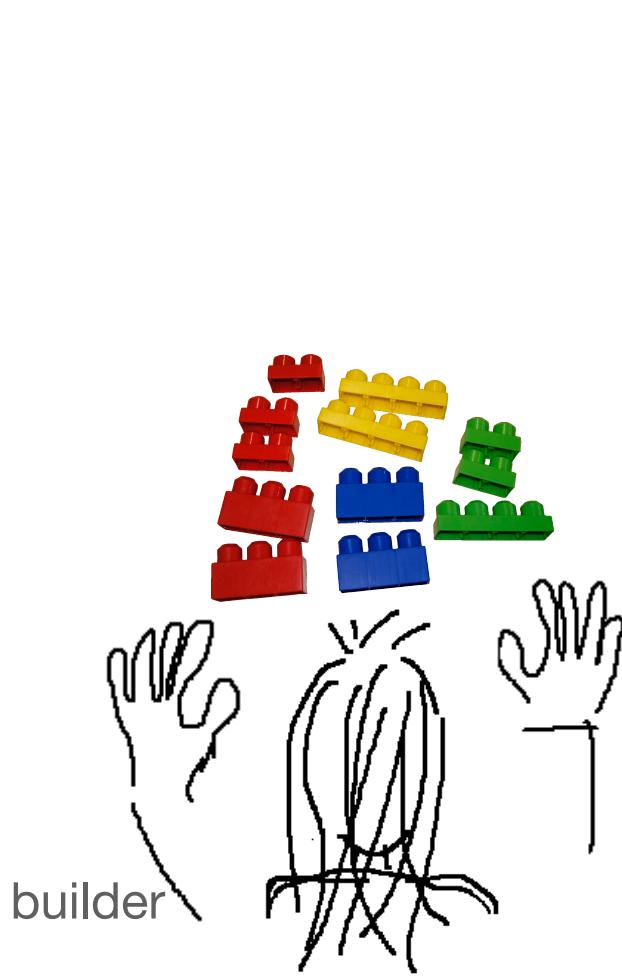
builder

architect

The Co-co Game – Setup



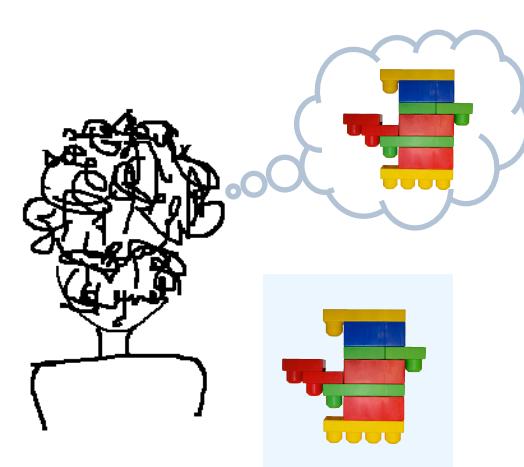
The Co-co Game – Setup



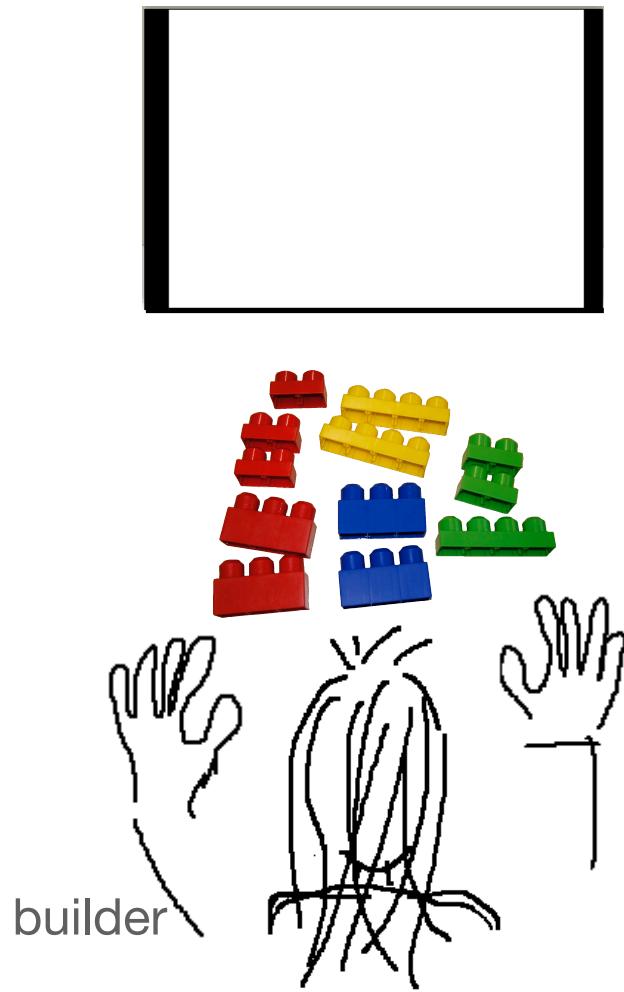
wall



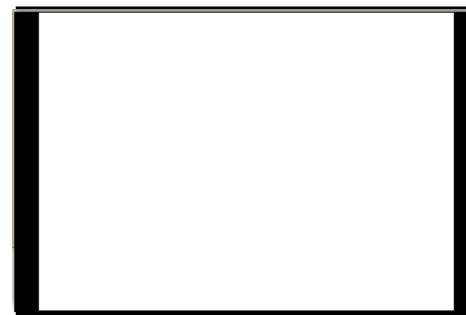
architect



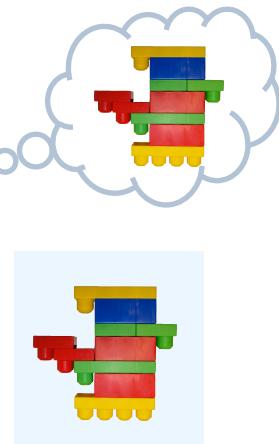
The Co-co Game – Setup



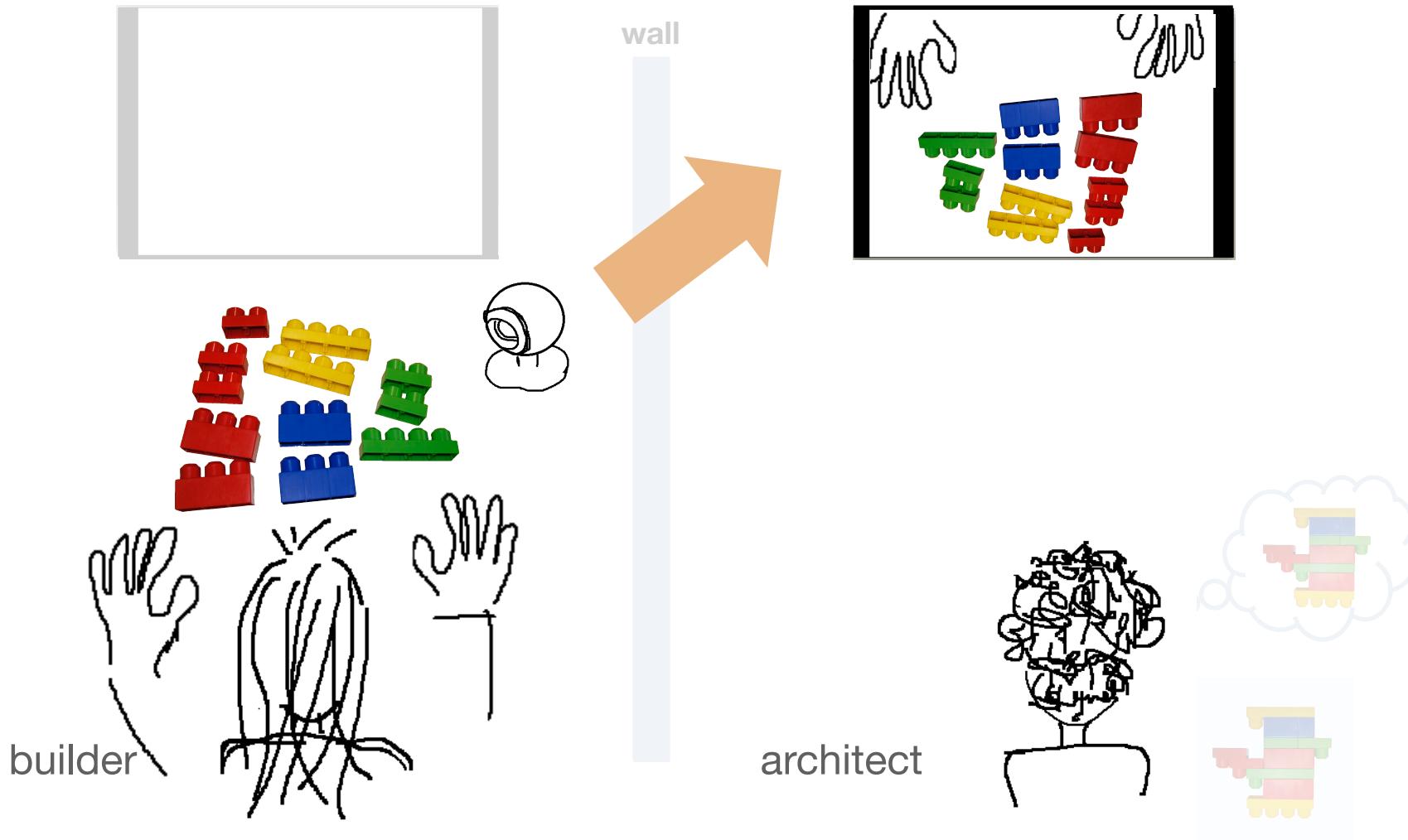
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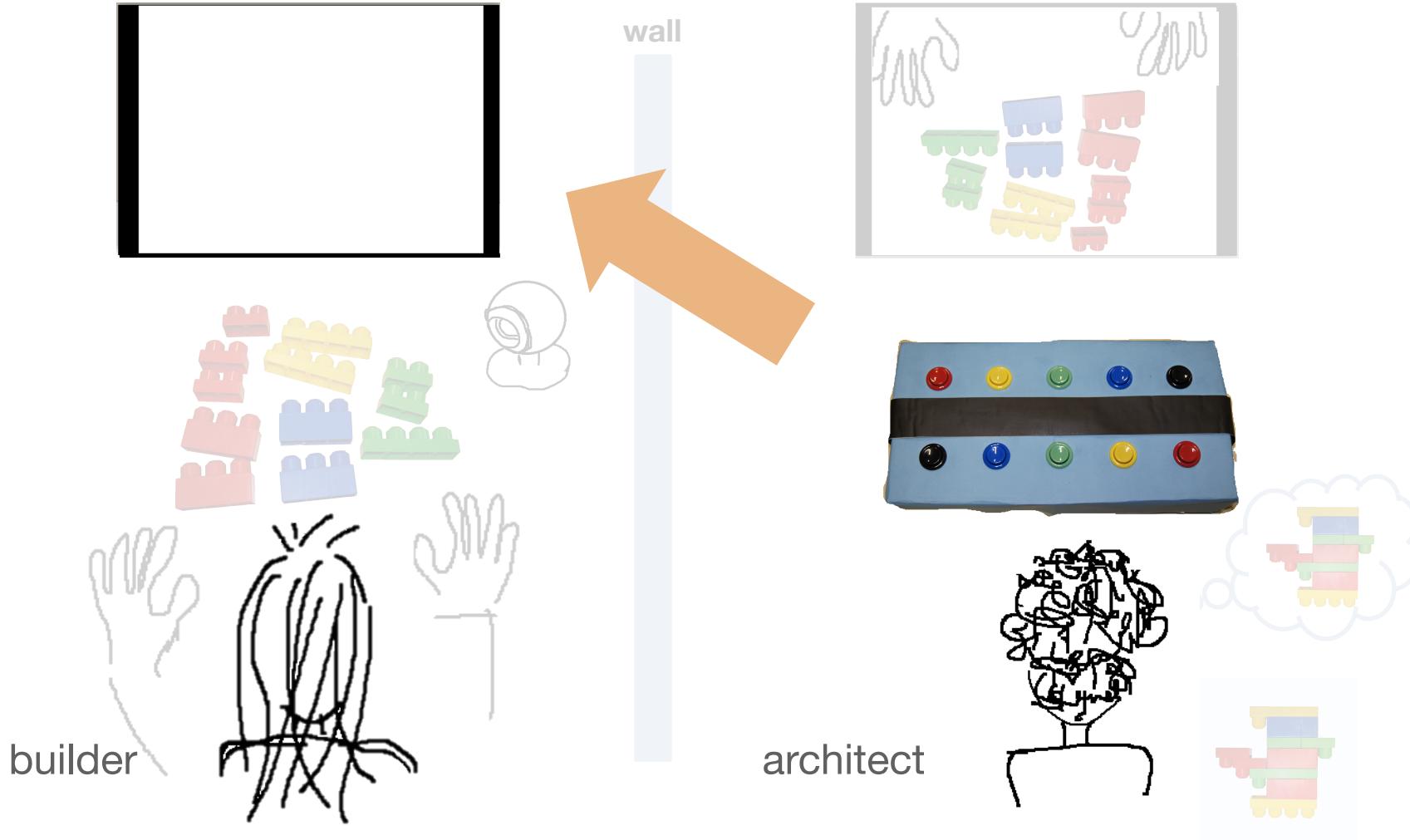
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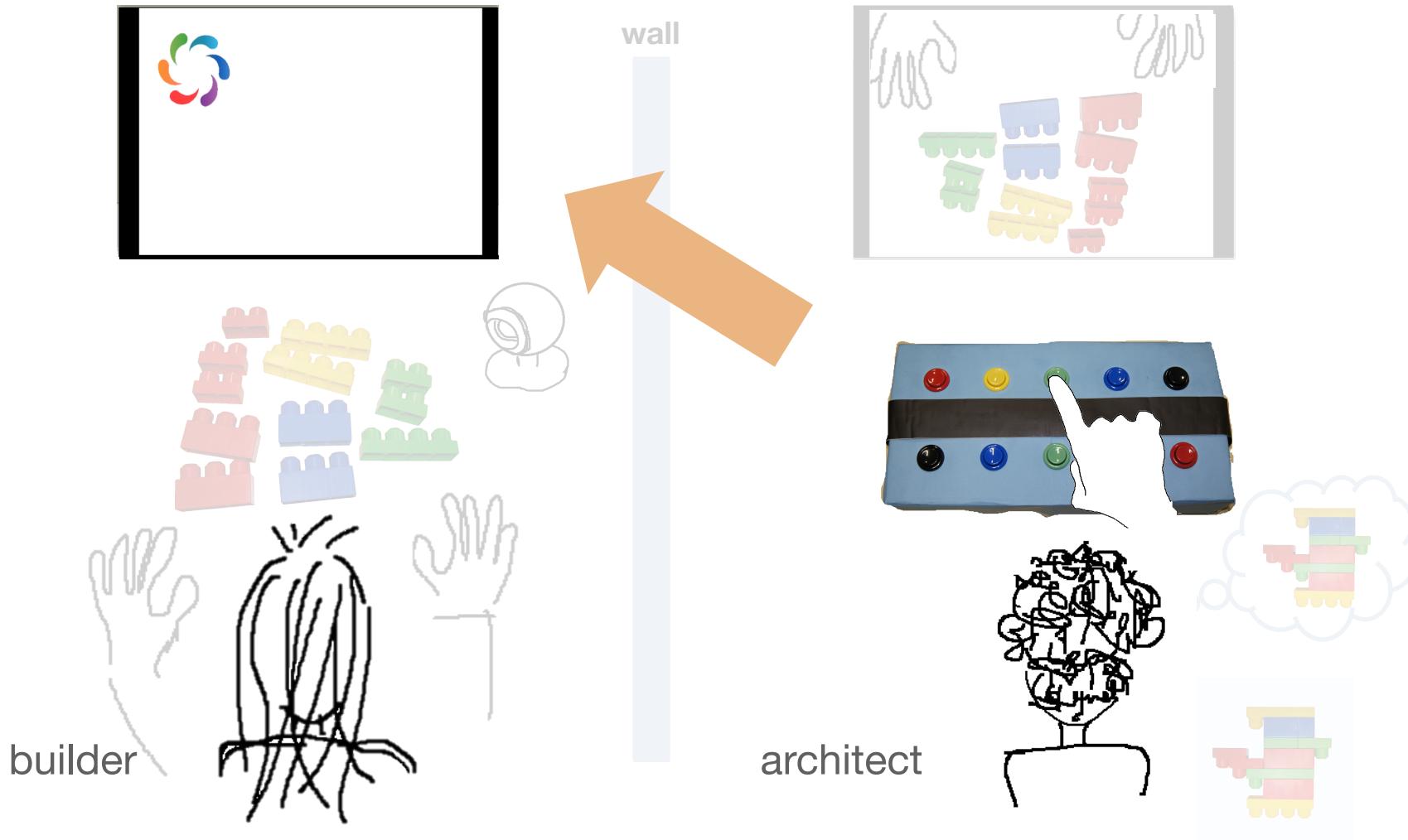
The Co-co Game – Setup



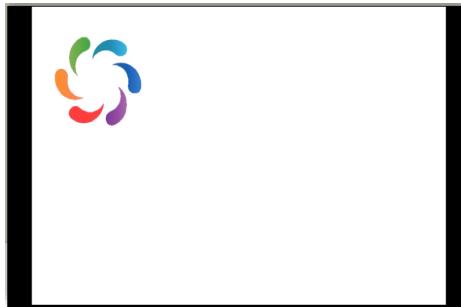
The Co-co Game – Setup



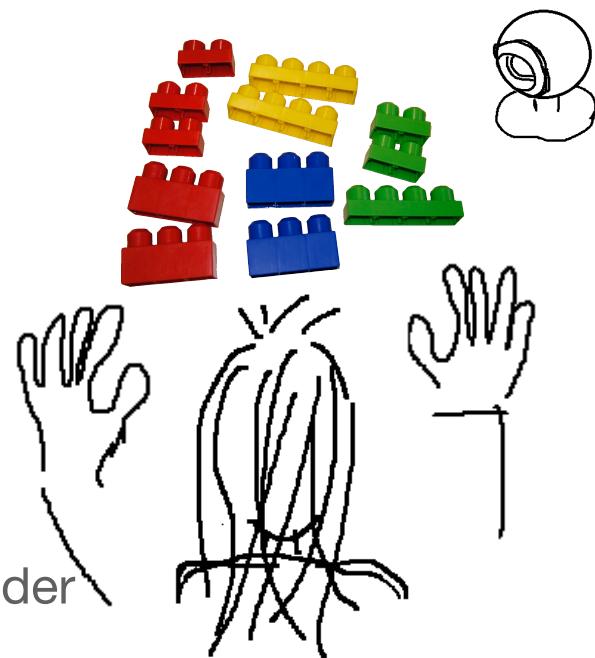
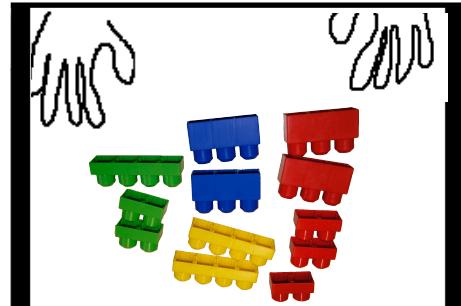
The Co-co Game – Setup



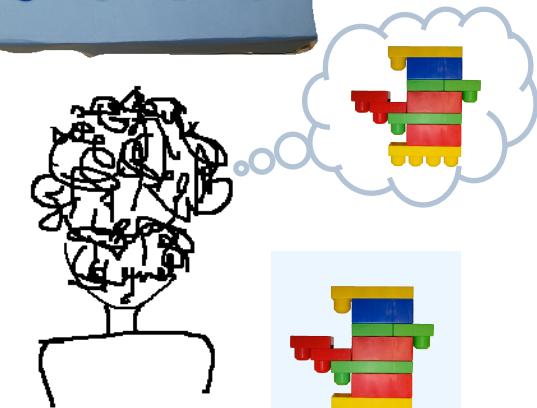
The Co-co Game - setup



wall



architect



The Co-co Game – Setup

Symbols:

- neutral
- neither their shape nor color are related to the task
- fixed position, but mapping of button position to screen position arbitrary



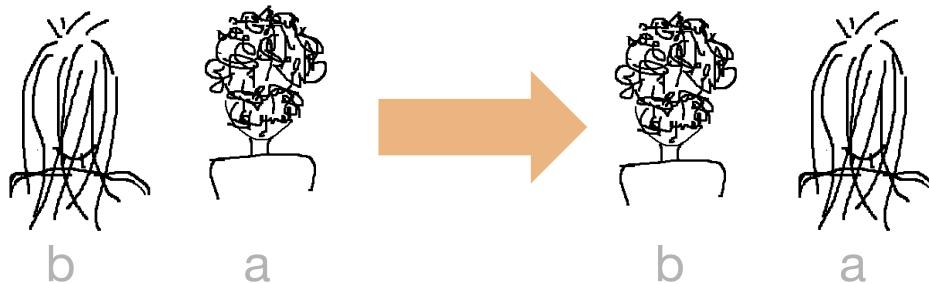
Builders should not use conventional gestures.

End: The game ends, when the builder decides that he/she has built the target structure correctly.

The Co-co Game – Pilot study

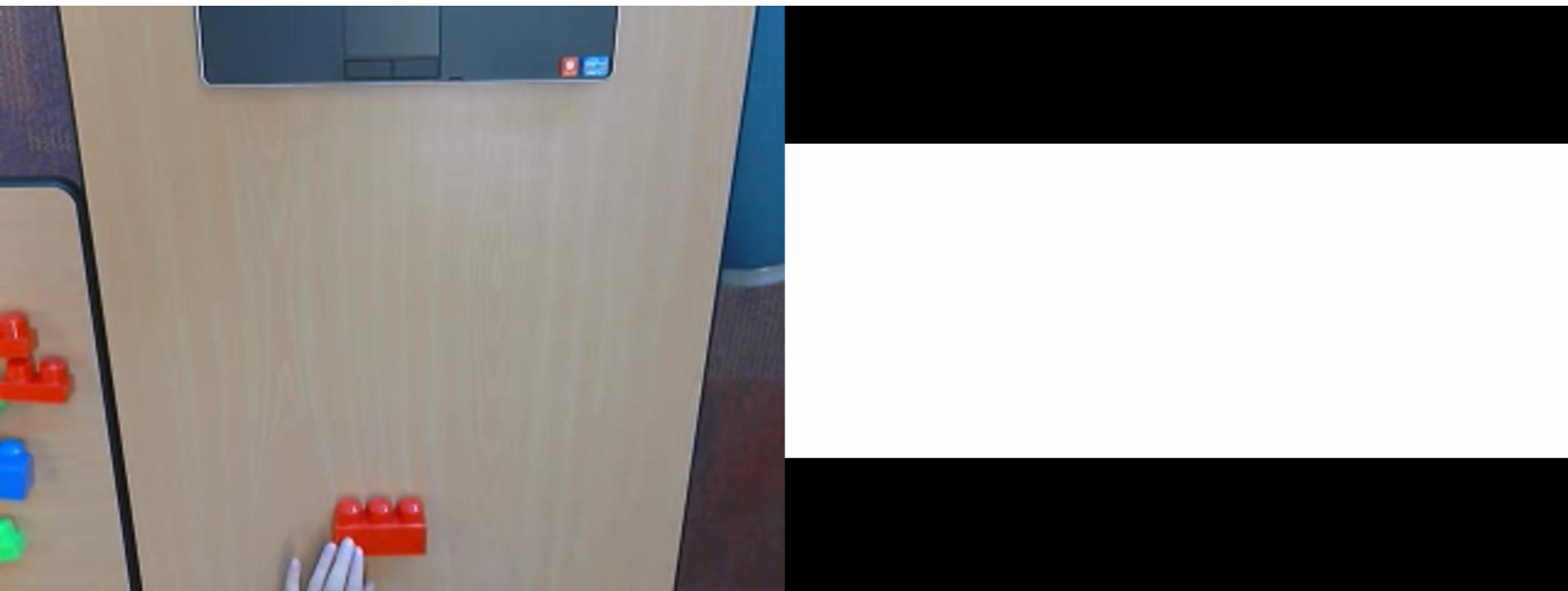
22 participants (11 pairs)

7 pairs played the game for a second round for which they switched roles.



For analysis in total: 17 rounds (one round excluded)

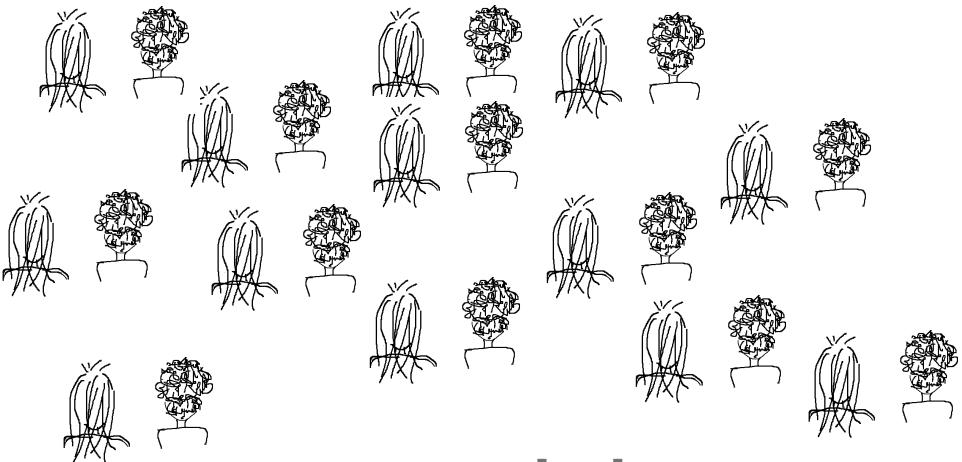
The Co-co Game – Pilot study



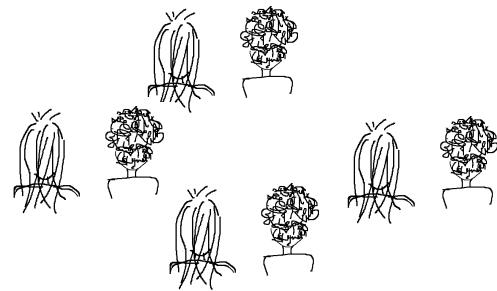
The Co-co Game – Pilot study



The Co-co Game – Pilot study



succeeded

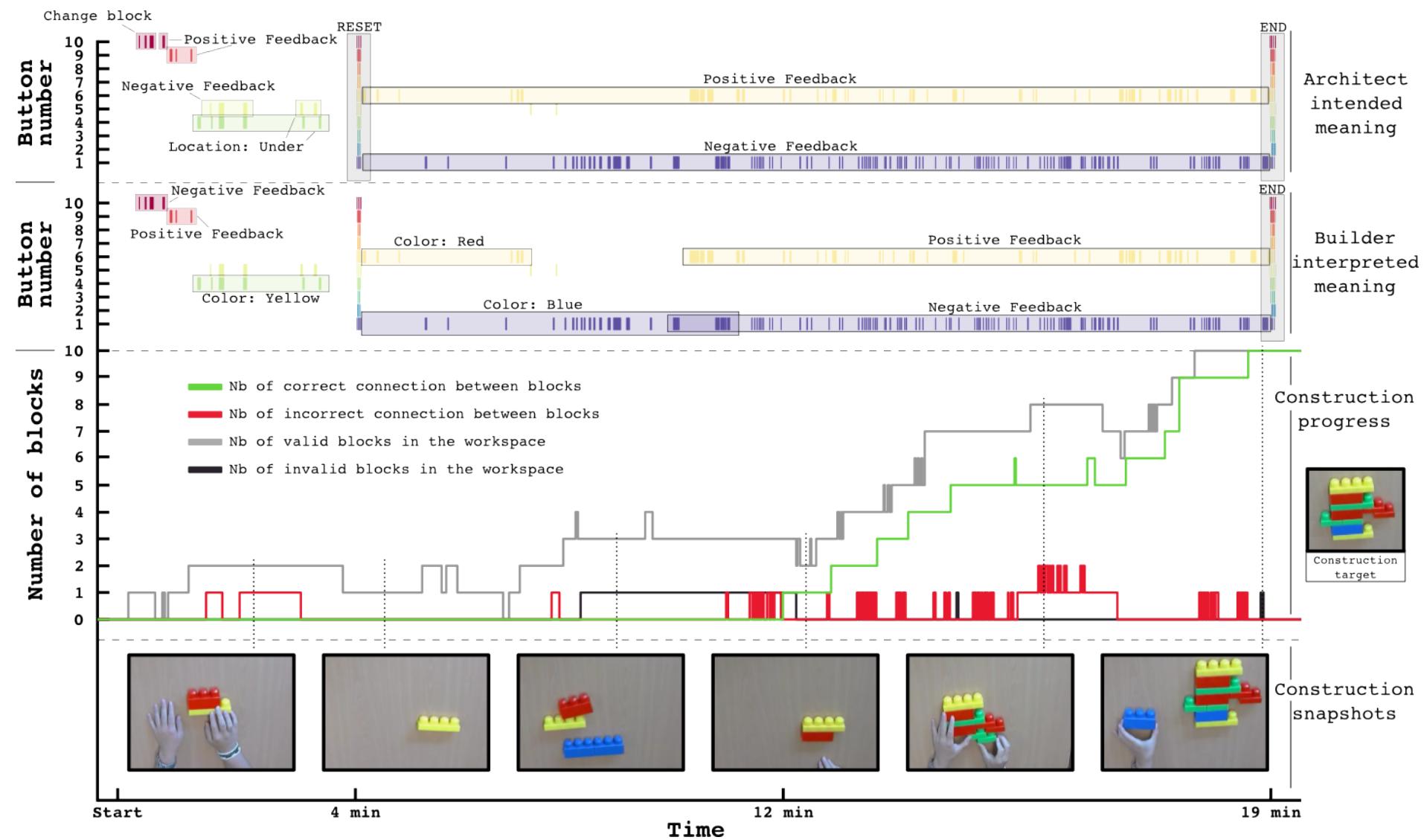


failed

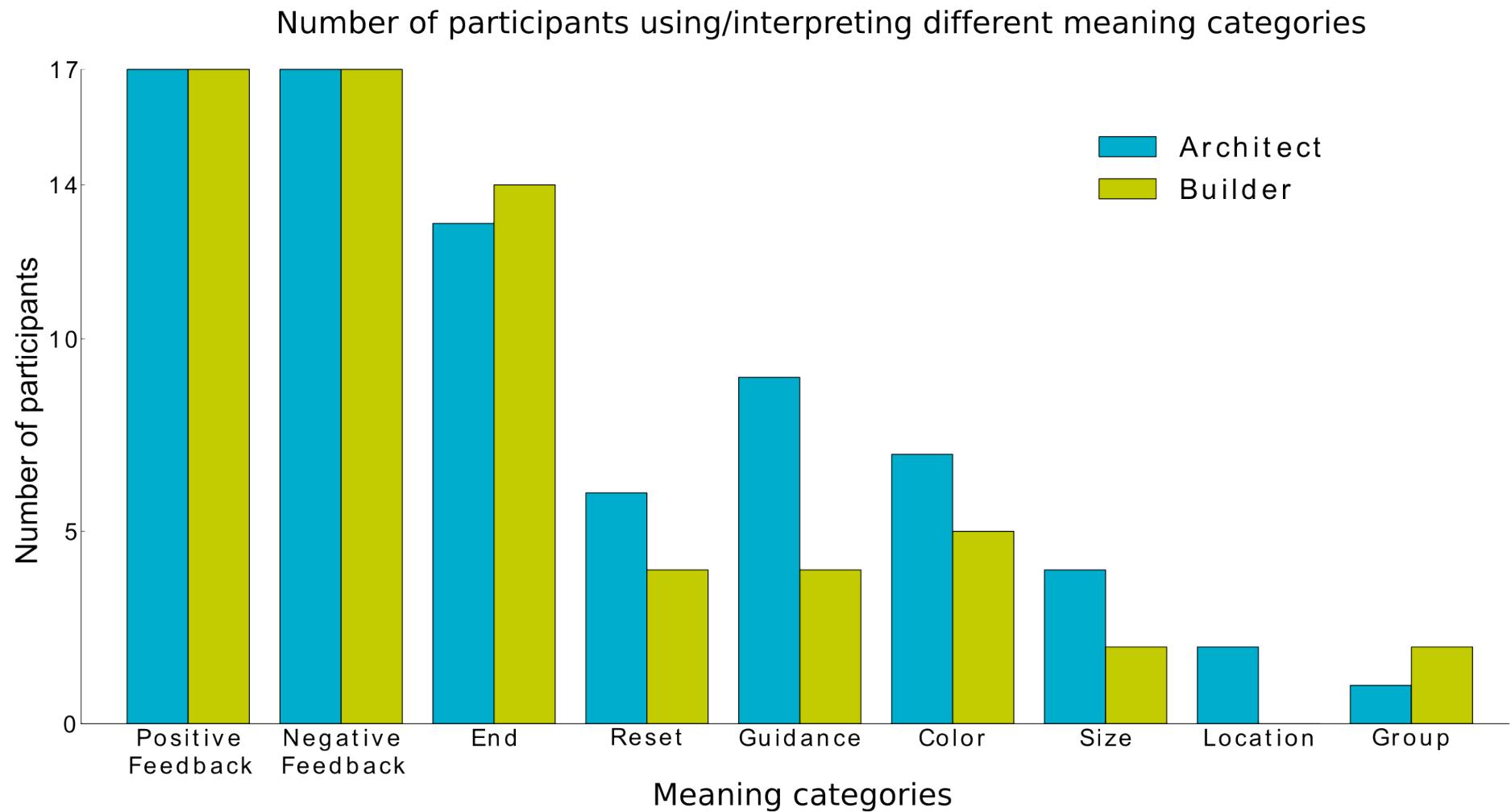
13 of the 17 rounds were successful and 4 failed.

The average duration of the runs was 18 minutes
with a minimum of 7 minutes and a maximum of 45 minutes.

The Co-co Game – Pilot study

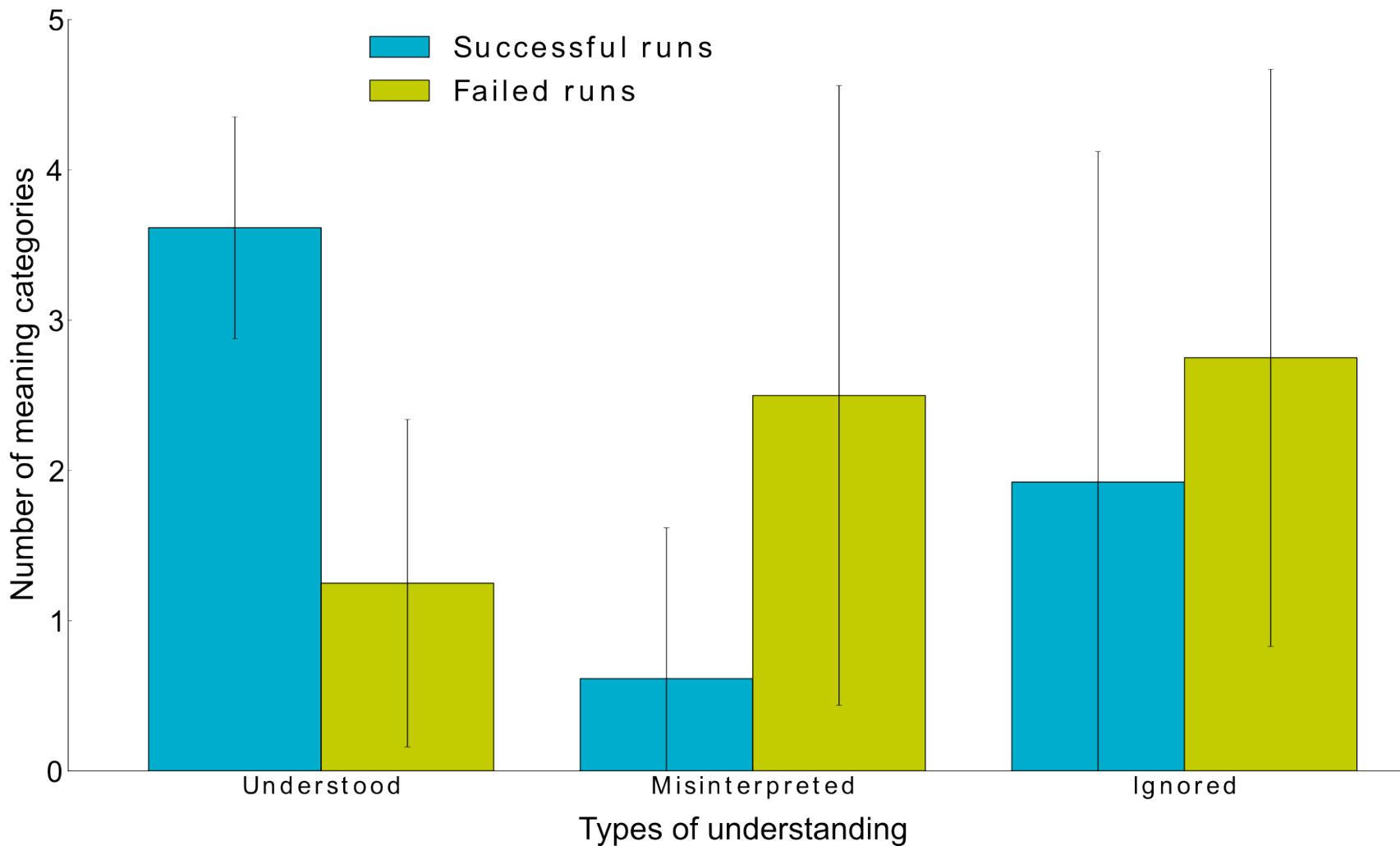


The Co-co Game – Pilot study



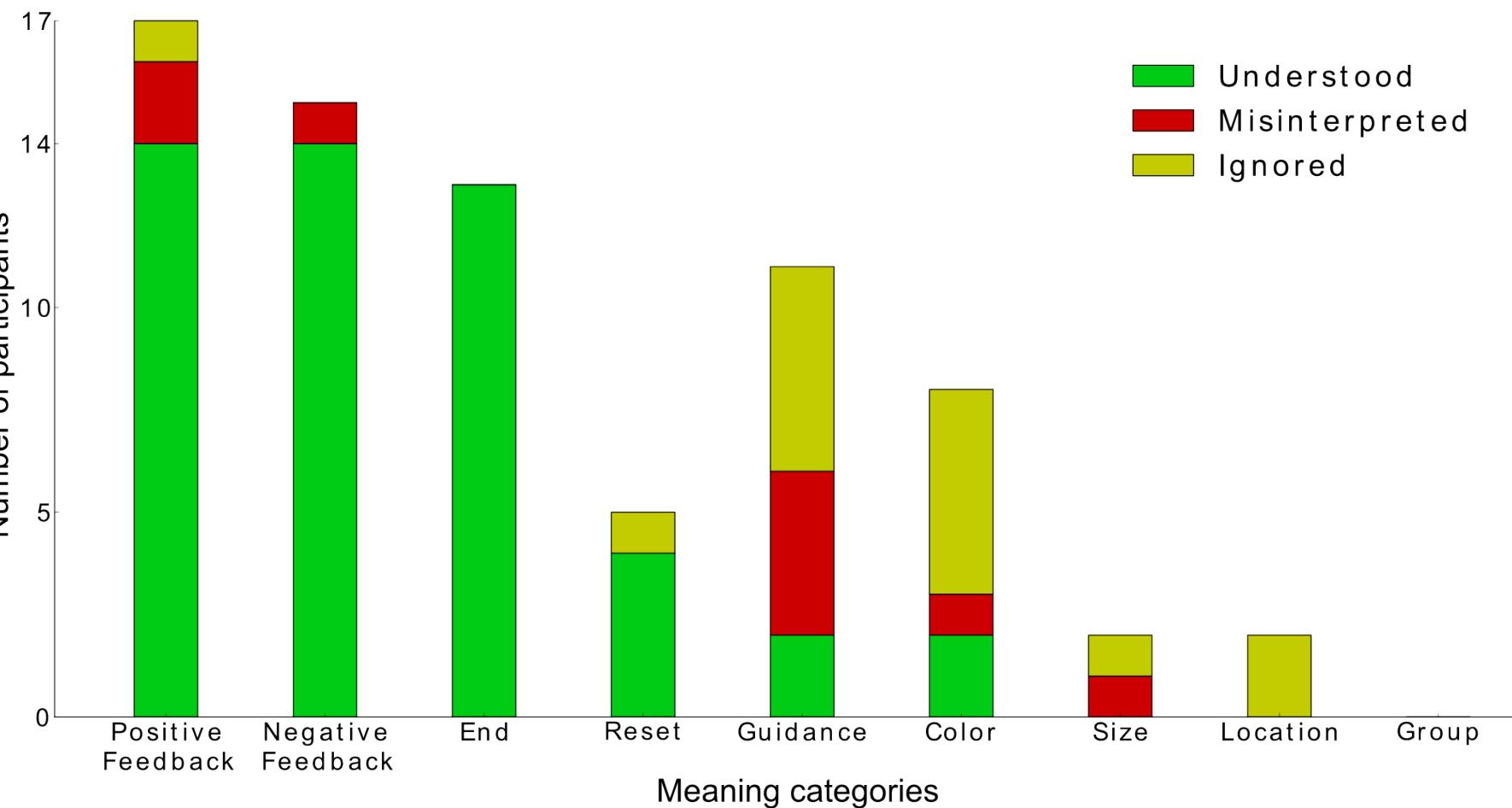
The Co-co Game – Pilot study

Number of meaning categories understood for successful and failed experiments



The Co-co Game – Pilot study

Number of builder/architect pairs agreeing on different meaning categories at the end of an experiment



The Co-co Game – Pilot study

Humans seem to solve such restricted asymmetric interaction problems by projecting the interaction into different common frames of interaction and selecting the one that is most coherent with the history of interaction.

The “feedback frame” seems the most commonly thought about and the easiest to understand in the context of our experiment.

The Co-co Game – Pilot study

when interacting, humans make use of frames and interaction protocols

Frames

- create a common ground about the purpose of the interaction
- help to understand communicative intentions of partner
- provide guidelines about how to behave (interaction protocol)

The Co-co Game – Pilot study

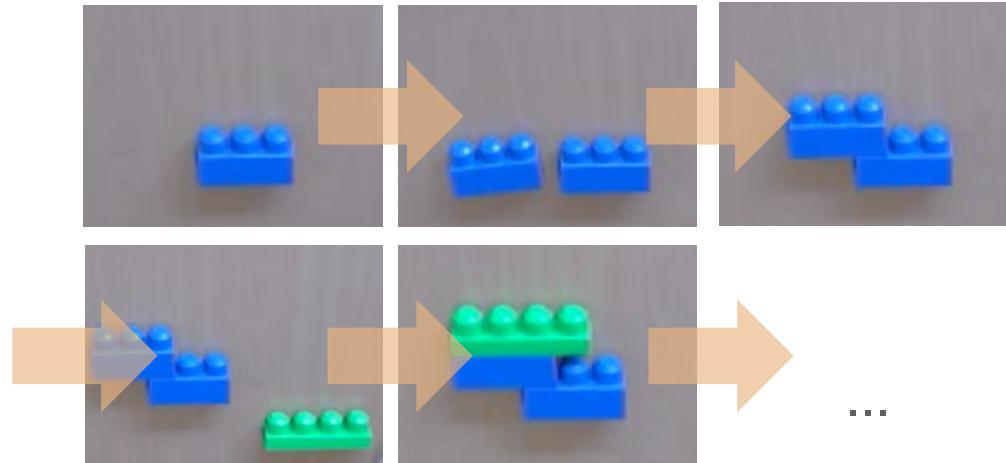
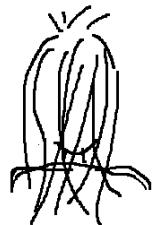
Two main **builder strategies**:

1. Find one block and join right away, repeat
2. Find all blocks belonging to the structure, then start joining

No strategy

The Co-co Game – Pilot study

1. Find one block and join right away, repeat

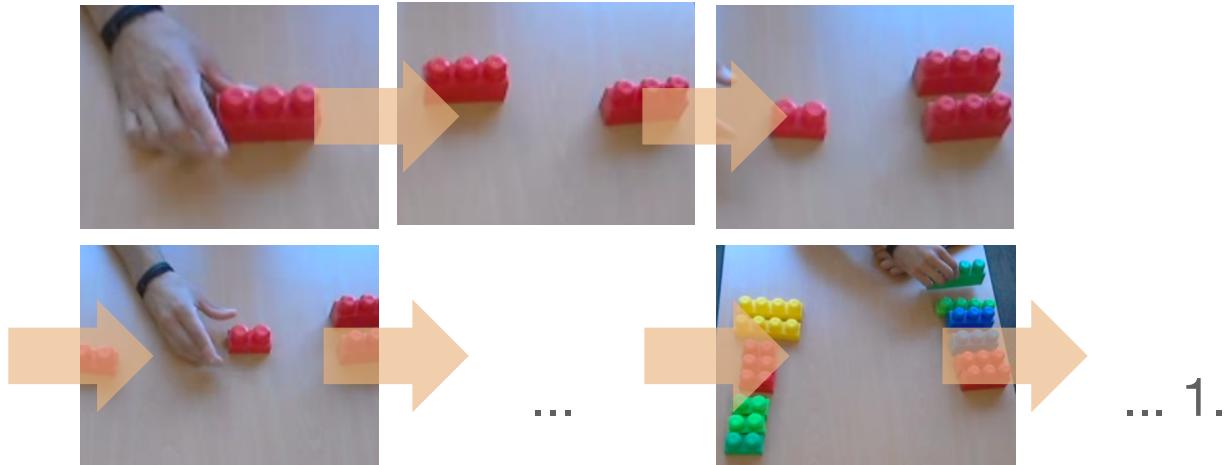
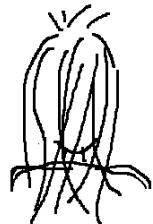


Number of rounds: 12

Successful: 11, Failed: 1

The Co-co Game – Pilot study

2. Find all blocks belonging to the structure, then start joining

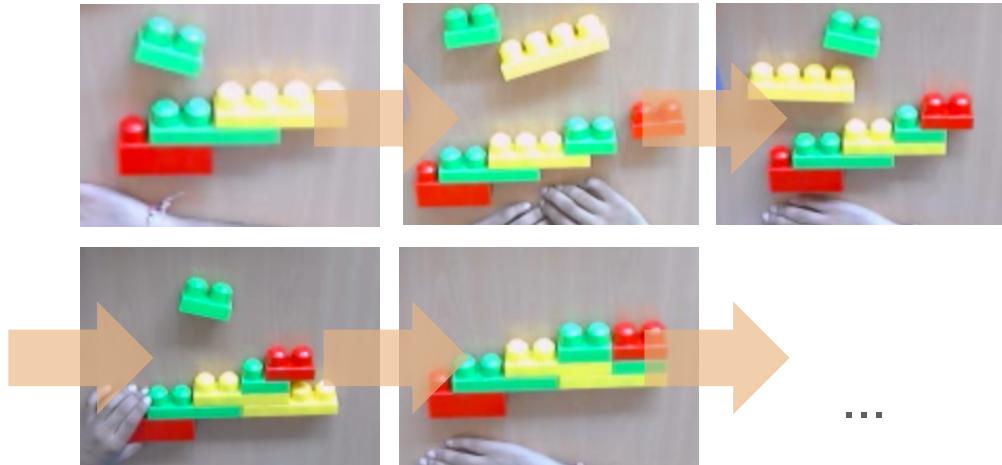
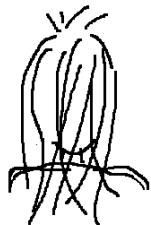


Number of rounds: 2

Successful: 2, Failed: 0

The Co-co Game – Pilot study

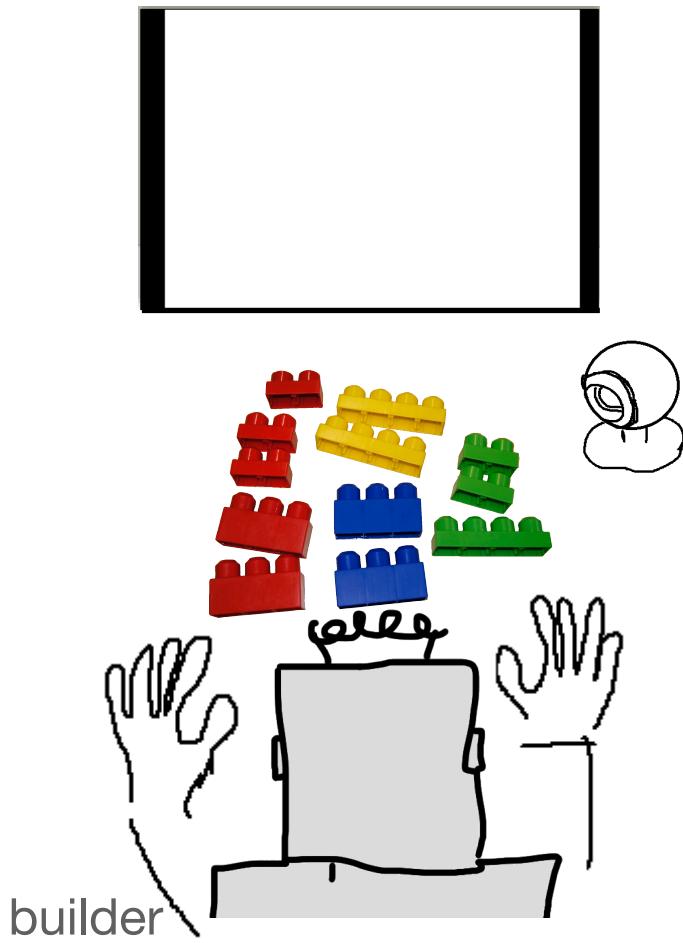
no strategy



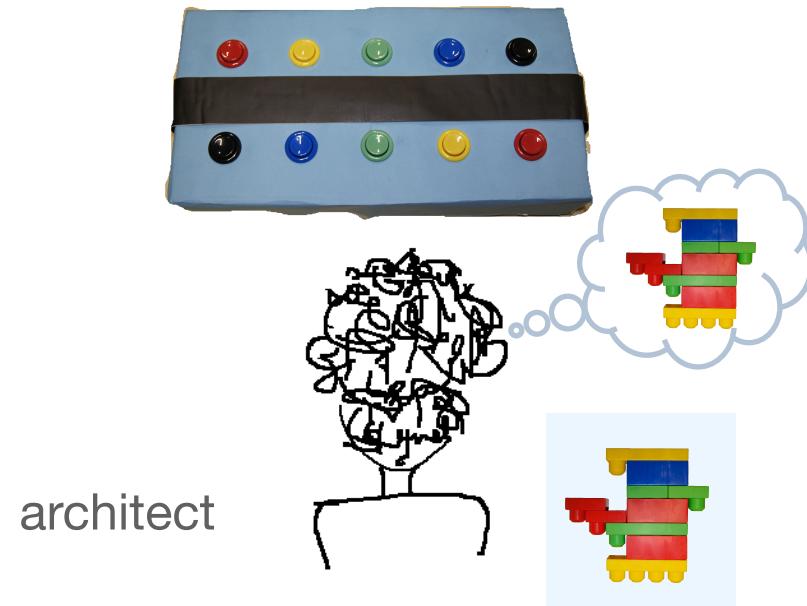
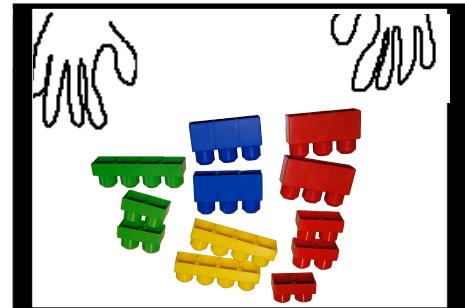
Number of rounds: 3

Successful: 0, Failed: 3

The Co-co Game – Human-Robot Interaction



wall



architect

The Co-co Game – Human-Robot Interaction

equip the robot with

- a set of common interaction frames
- a mechanism of proposition of frames to elicit appropriate signals from a human tutor

Thank you!