

« Human-Robot Joint Action: Refining the understanding of joint action through an interdisciplinary perspective »
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On a Multidisciplinary Analysis of Joint Activity

Kathleen Belhassein

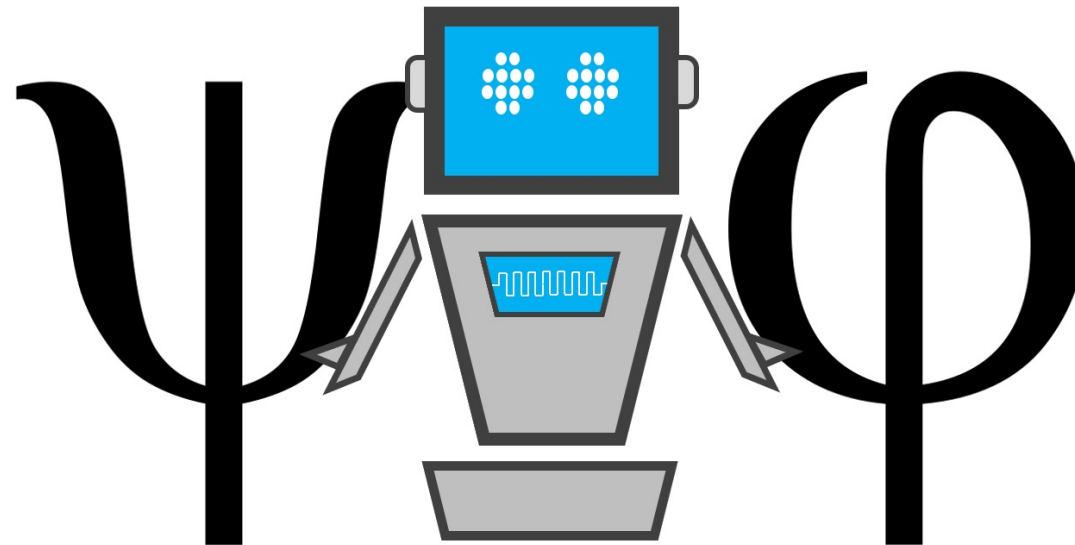
PhD Student

CLLE, LTC
LAAS-CNRS, RIS



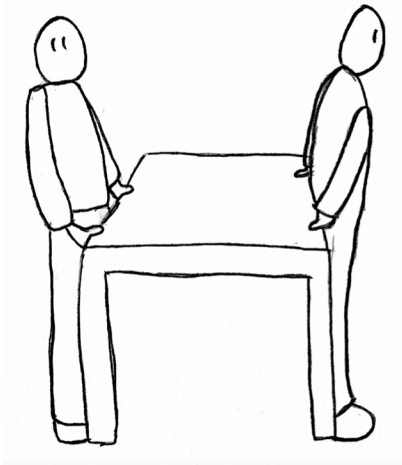
JointAction4HRI Project

Collaborative Research Project JA4HRI:
Psychology, Robotics, Philosophy

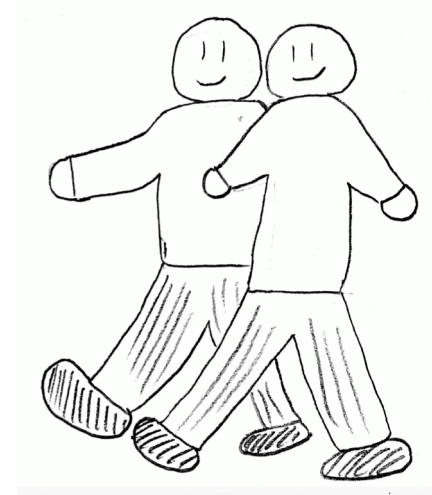


And what about joint action?

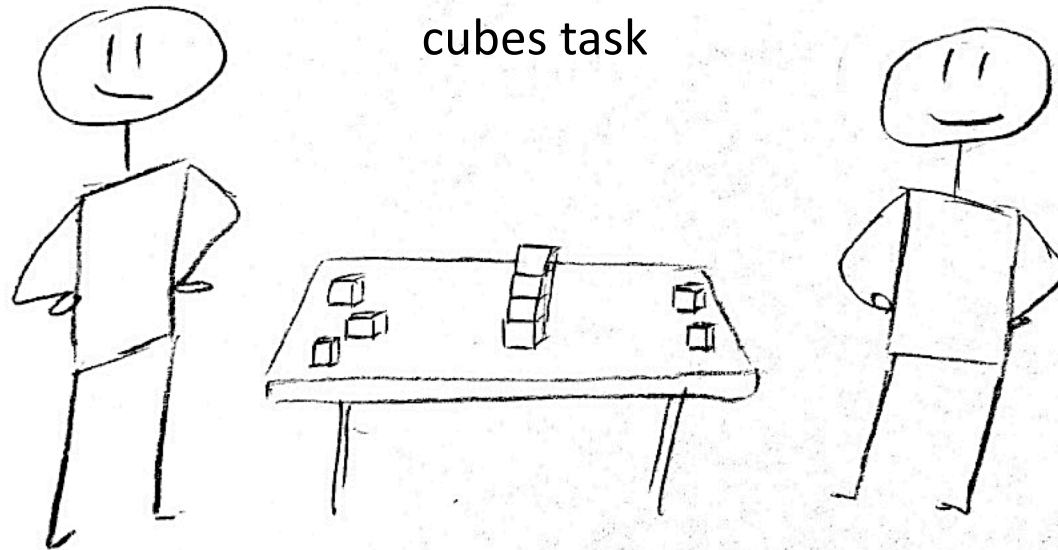
- Catch-all term
- No consensus

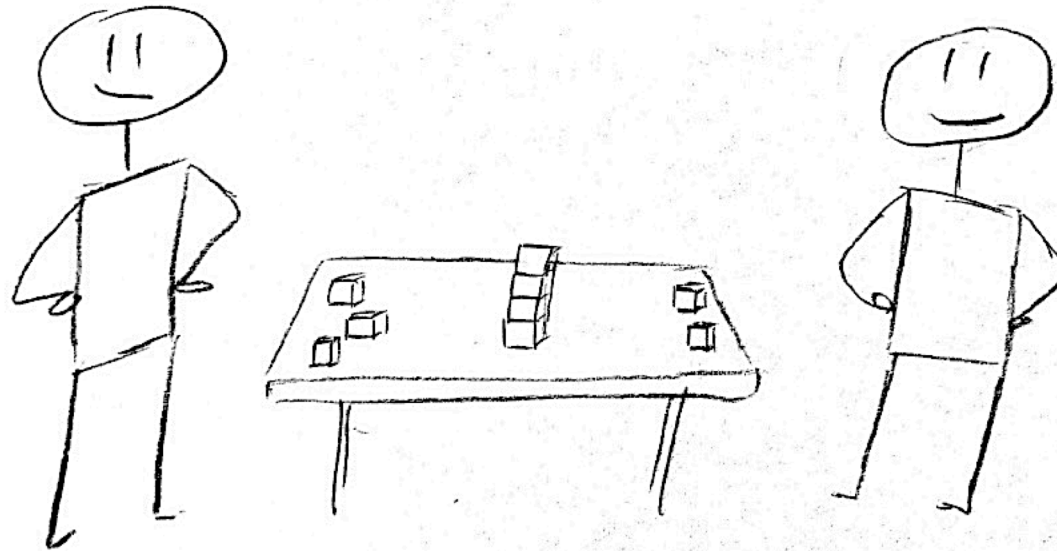


Sebanz, Bekkering & Knoblich, 2006



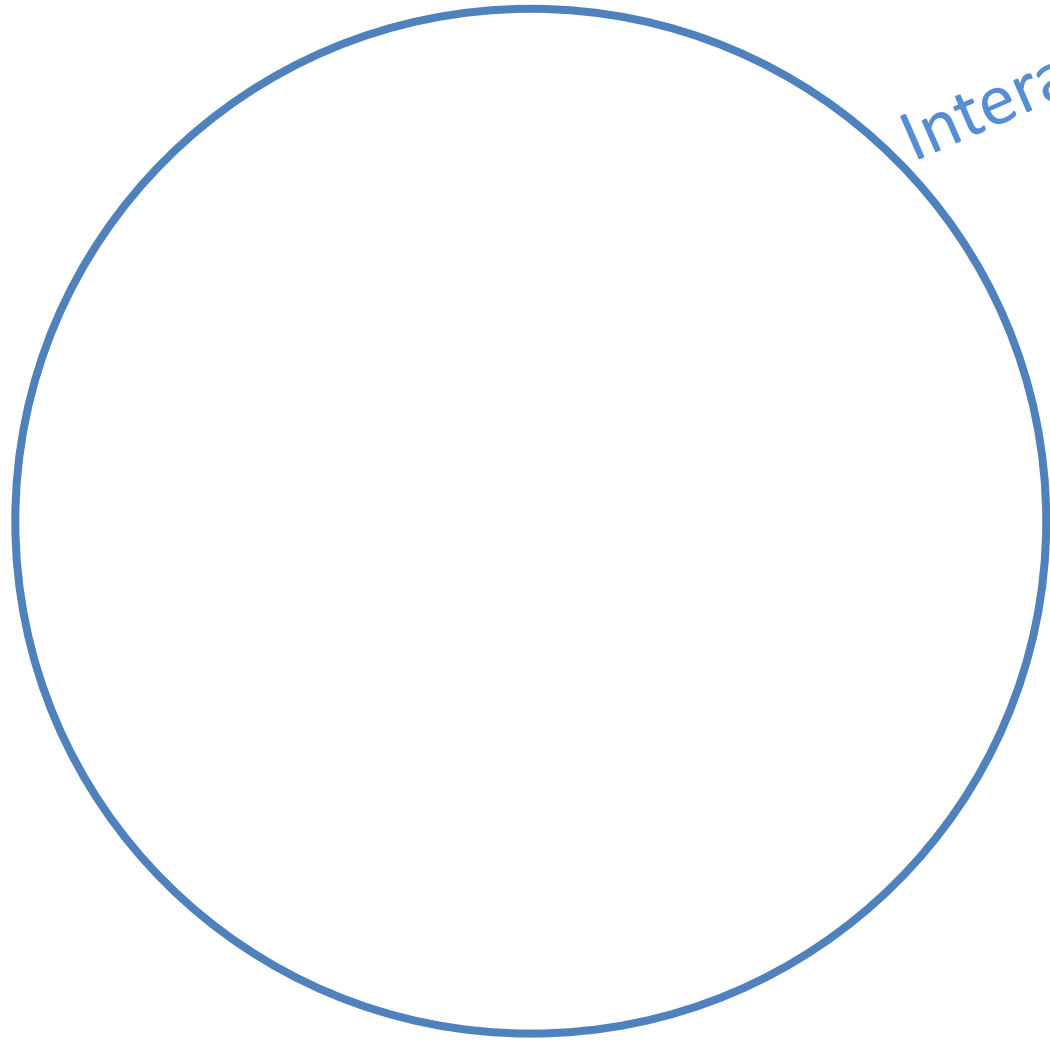
- Two partners
- Face to face
- Shared space
- Stack of cubes task

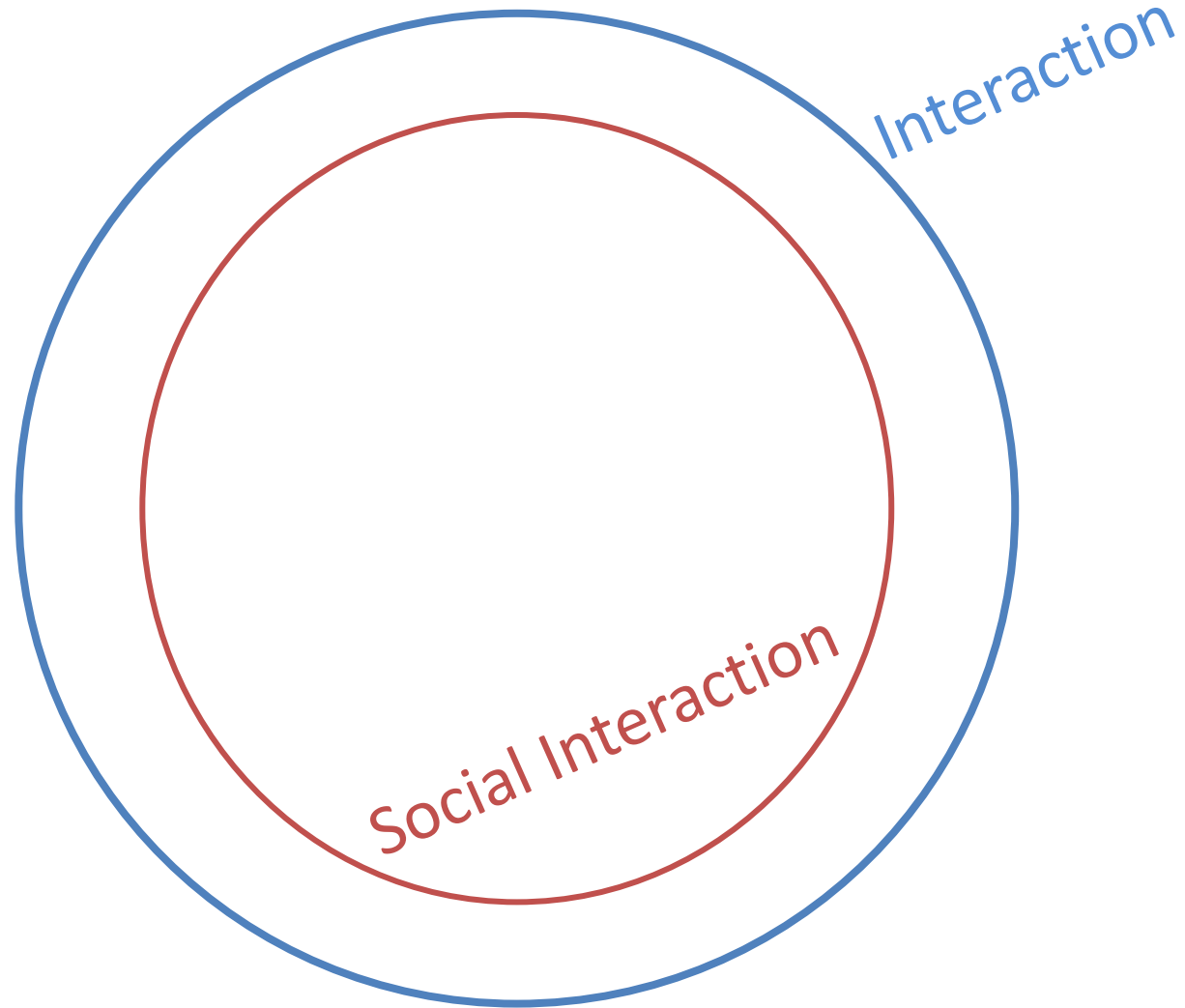


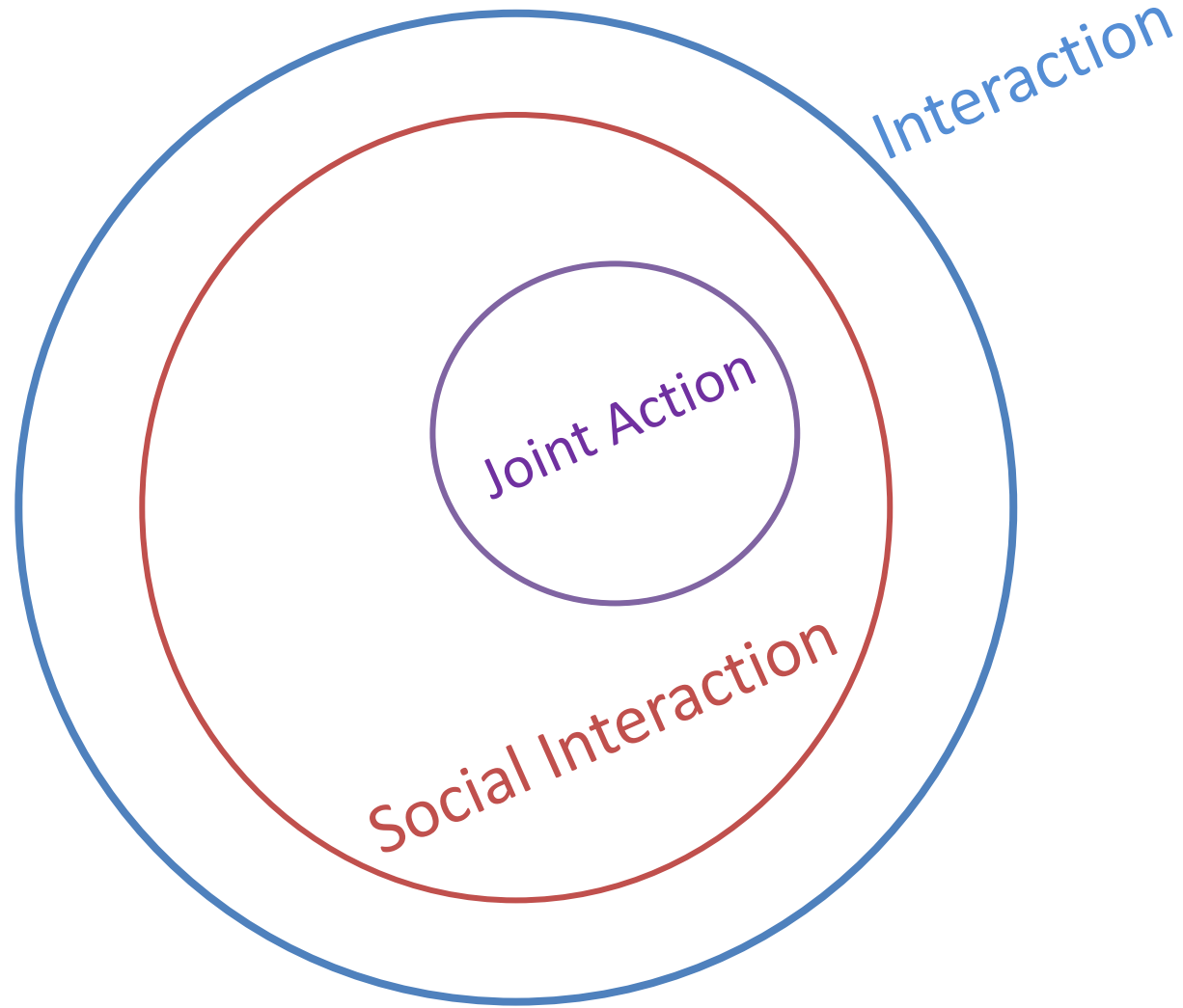


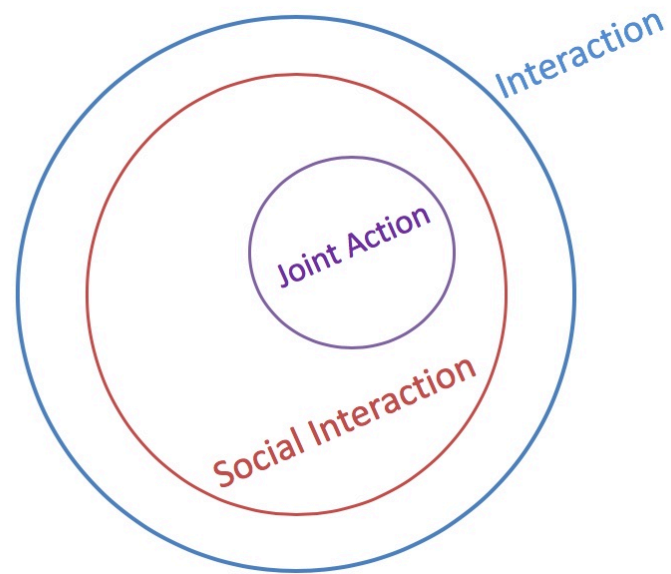
JOINT ACTION: WHAT ARE WE TALKING ABOUT?

Interaction









Sebanz, Bekkering & Knoblich (2006):

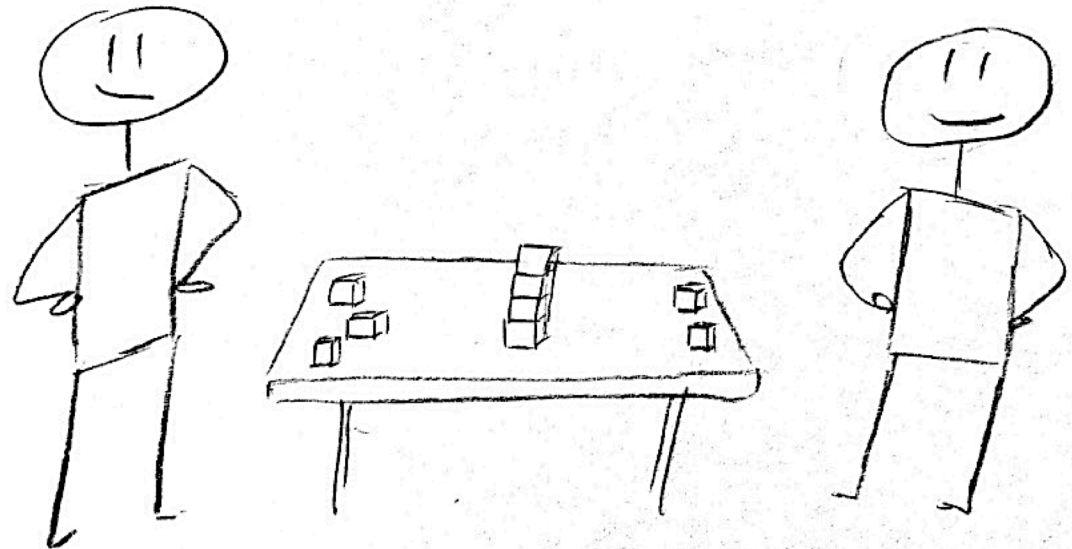
« Any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment. »

Joint action in animals?



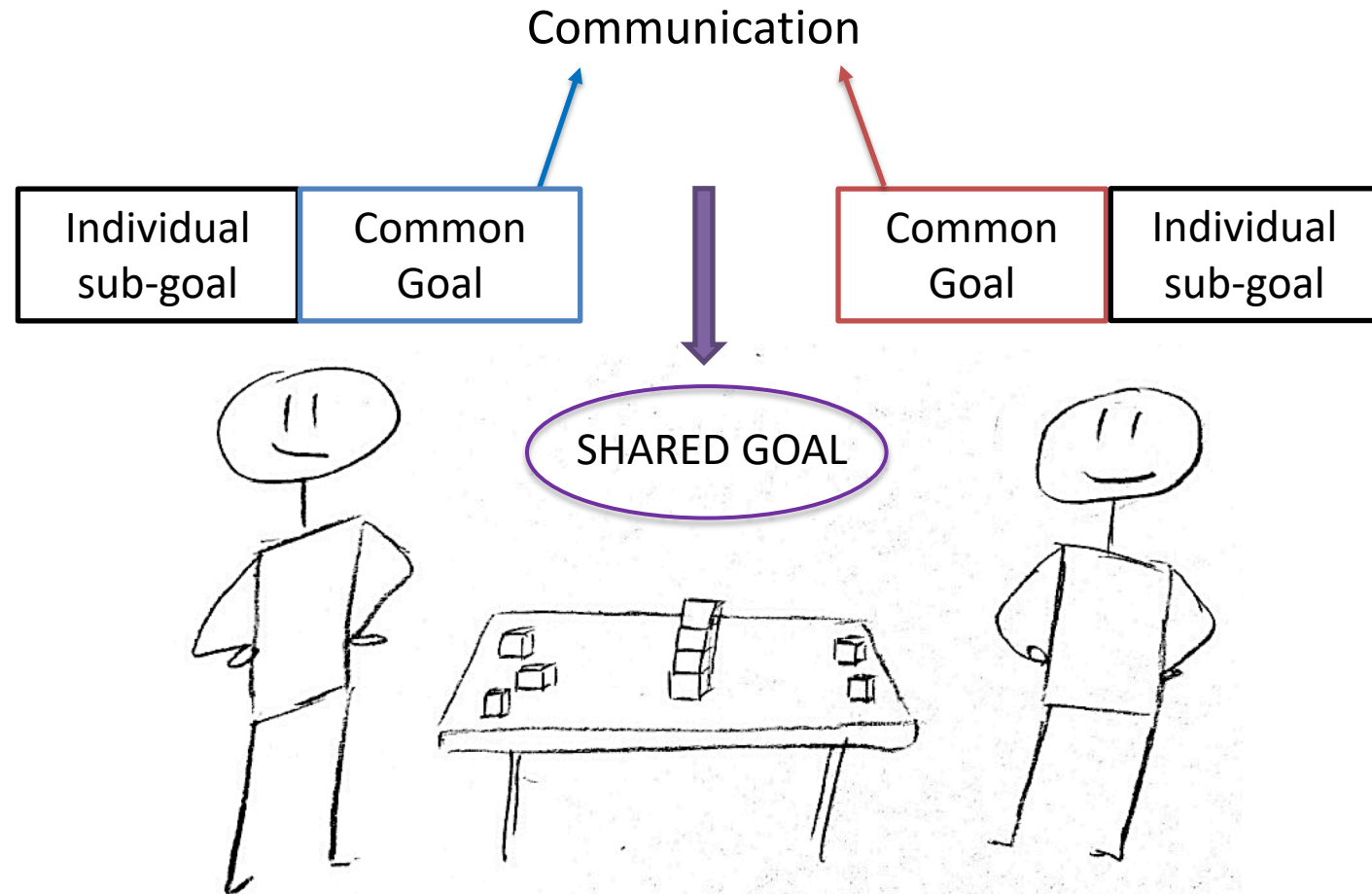
Shared intentions

- Common goal

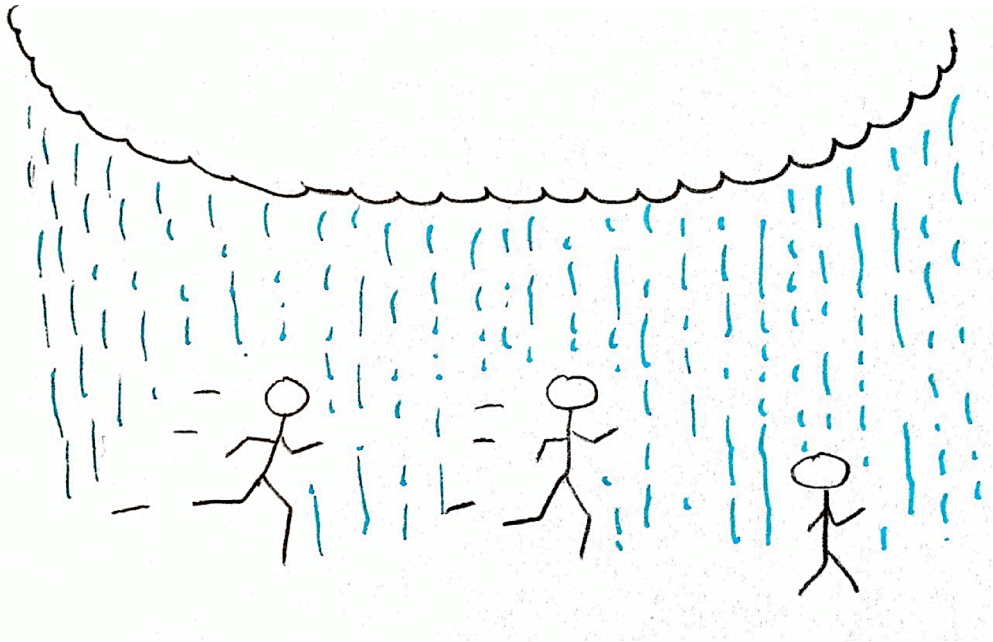


Shared intentions

- Common goal
- Common knowledge



Shared intentions

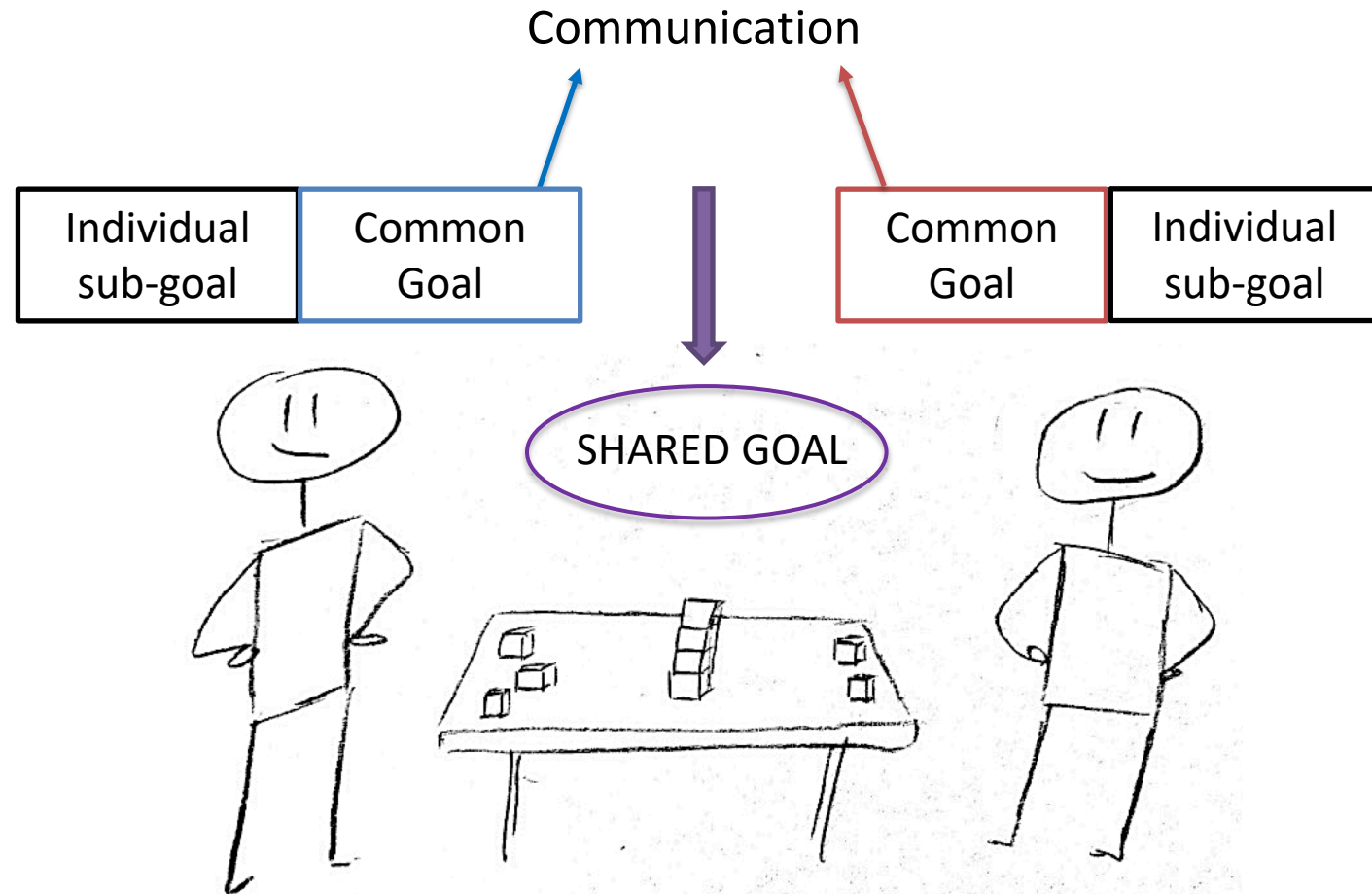


- Common goal of running to a sheltered place?
- Or part of an outdoor ballet?

Searle, J. (1990). Collective Intentions and Actions. In Philip R. Cohen Jerry Morgan & Martha Pollack (eds.), *Intentions in Communication*. MIT Press. pp. 401-415.

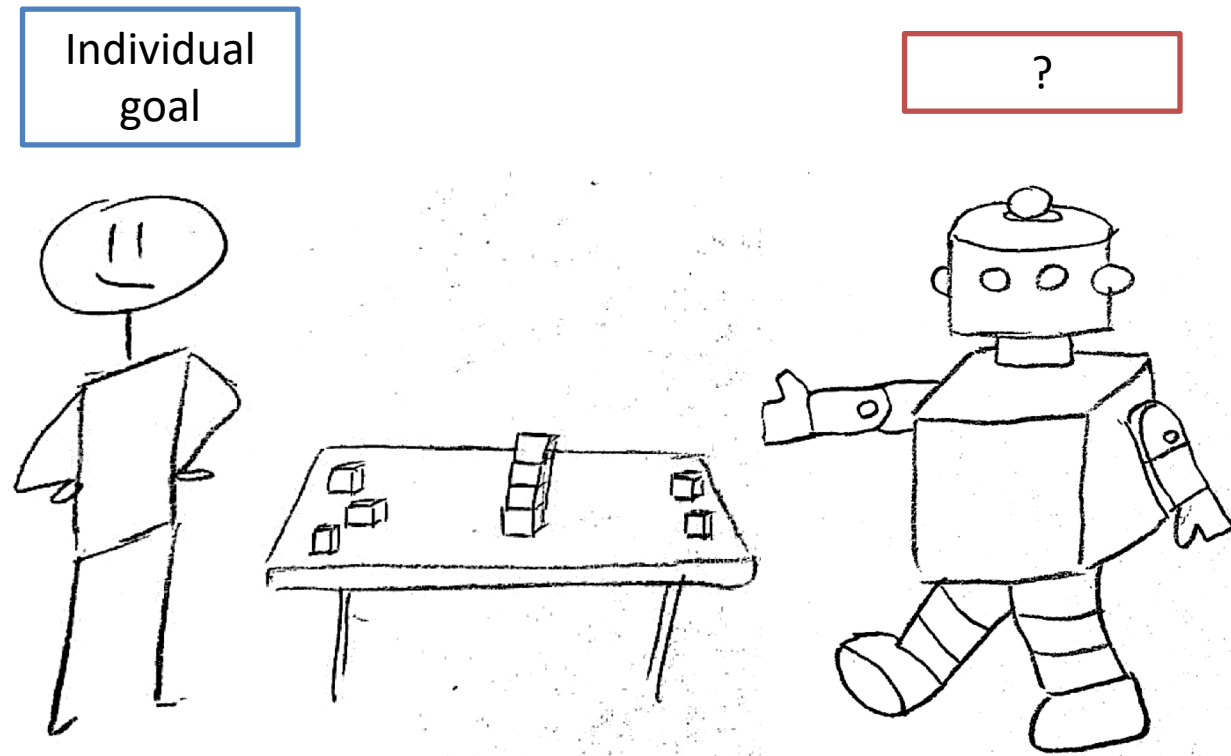
Shared intentions

- Common goal
- Common knowledge
- Collective intentionality
(Searle, 1990)



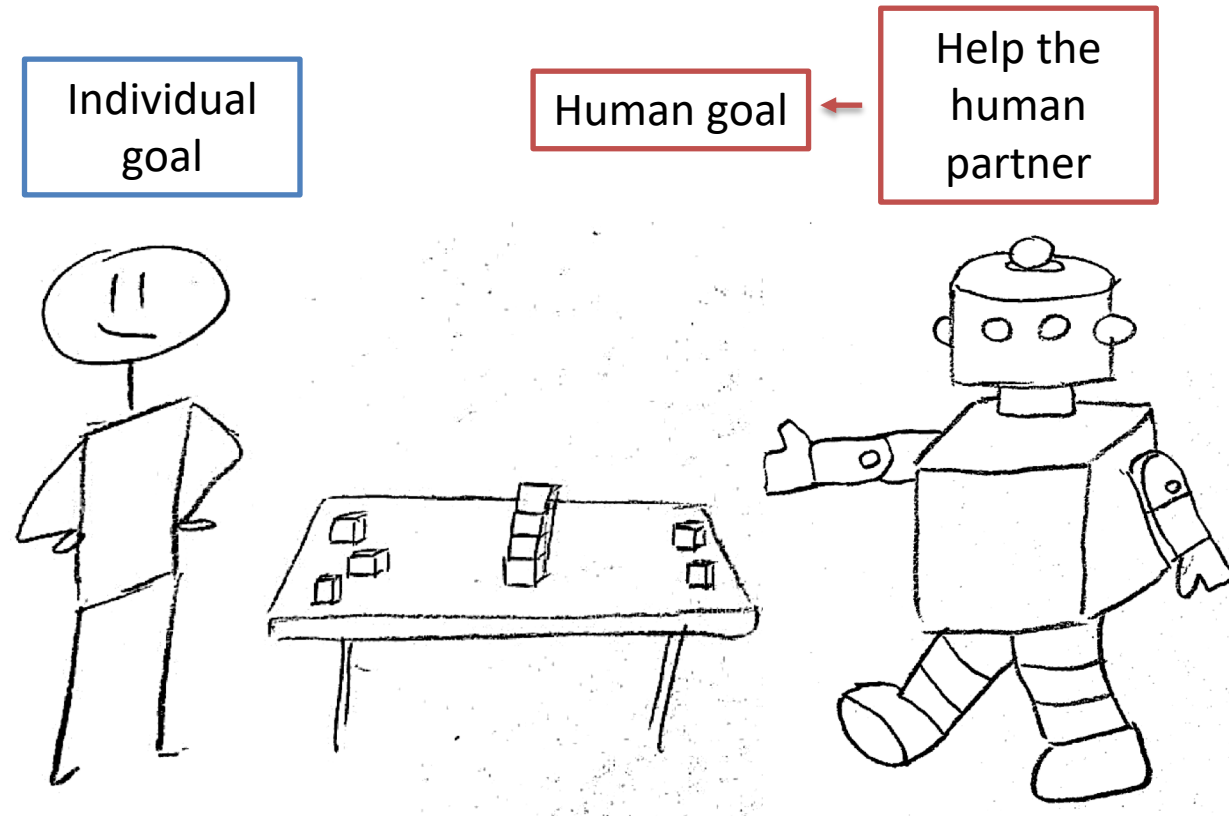
And what about the robot?

- Human: decide of the goal



And what about the robot?

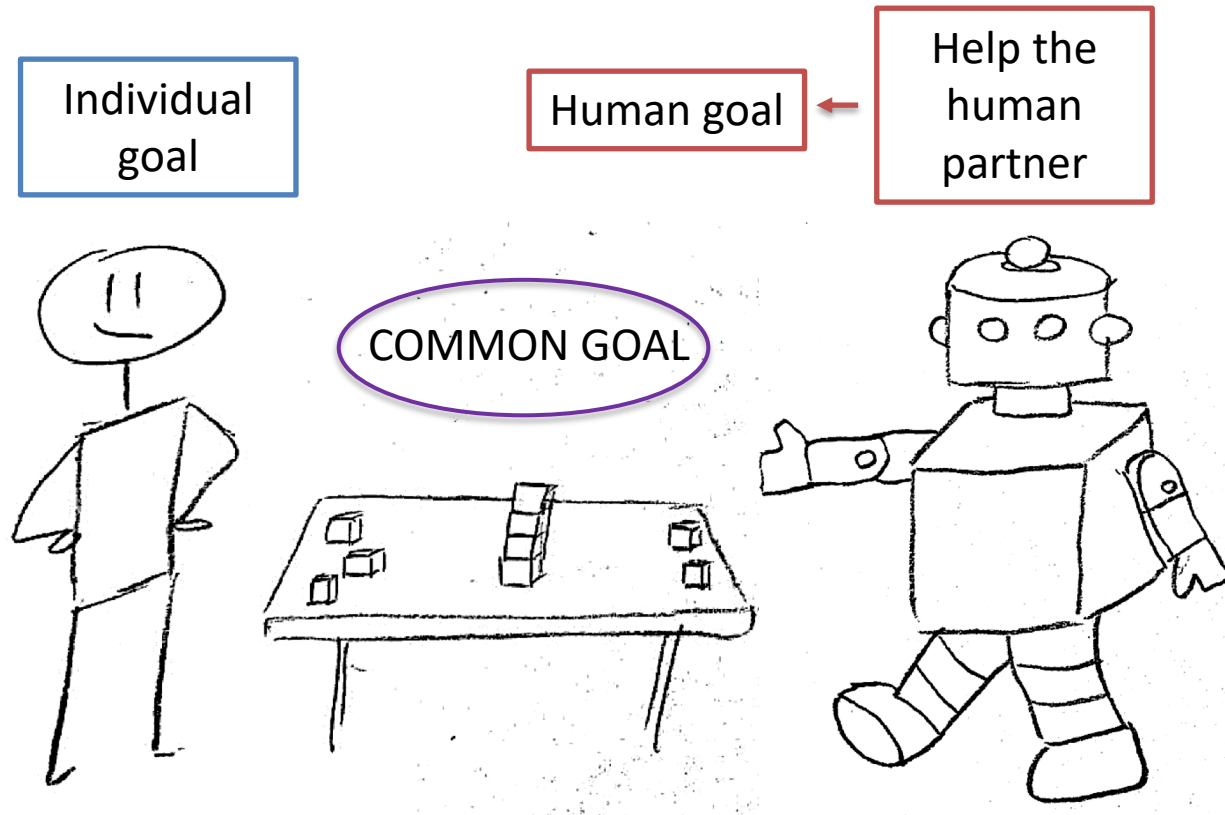
- Human: decide of the goal
- Robot: help the human + take human's intention as its own
(Bauer, Wollherr & Buss, 2007)



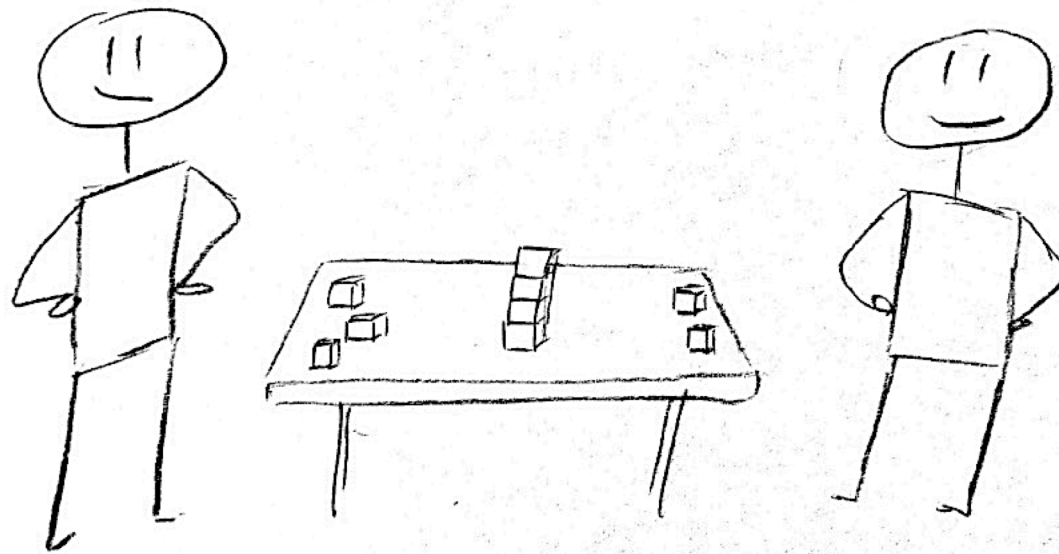
And what about the robot?

- Human: decide of the goal
- Robot: help the human + take human's intention as its own
(Bauer, Wollherr & Buss, 2007)

→ Joint 'intention' to reach a common goal

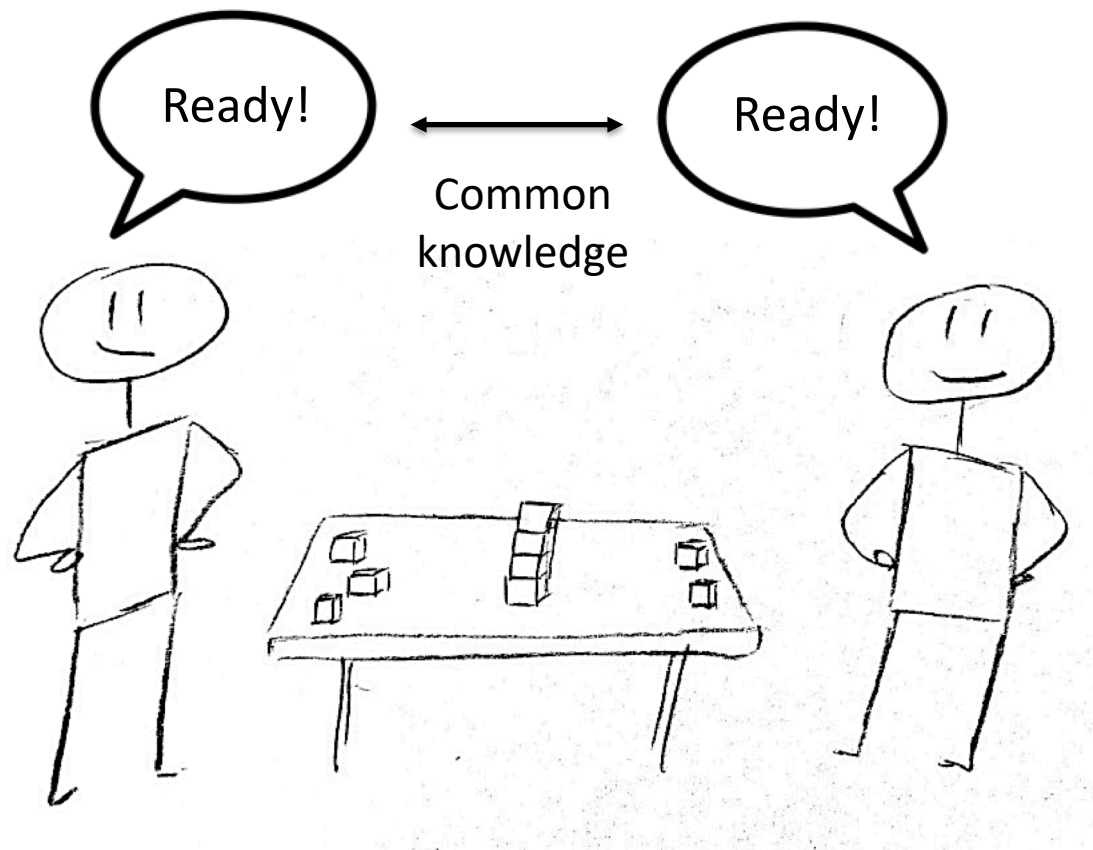


Joint commitment (to the joint activity) ¹⁸



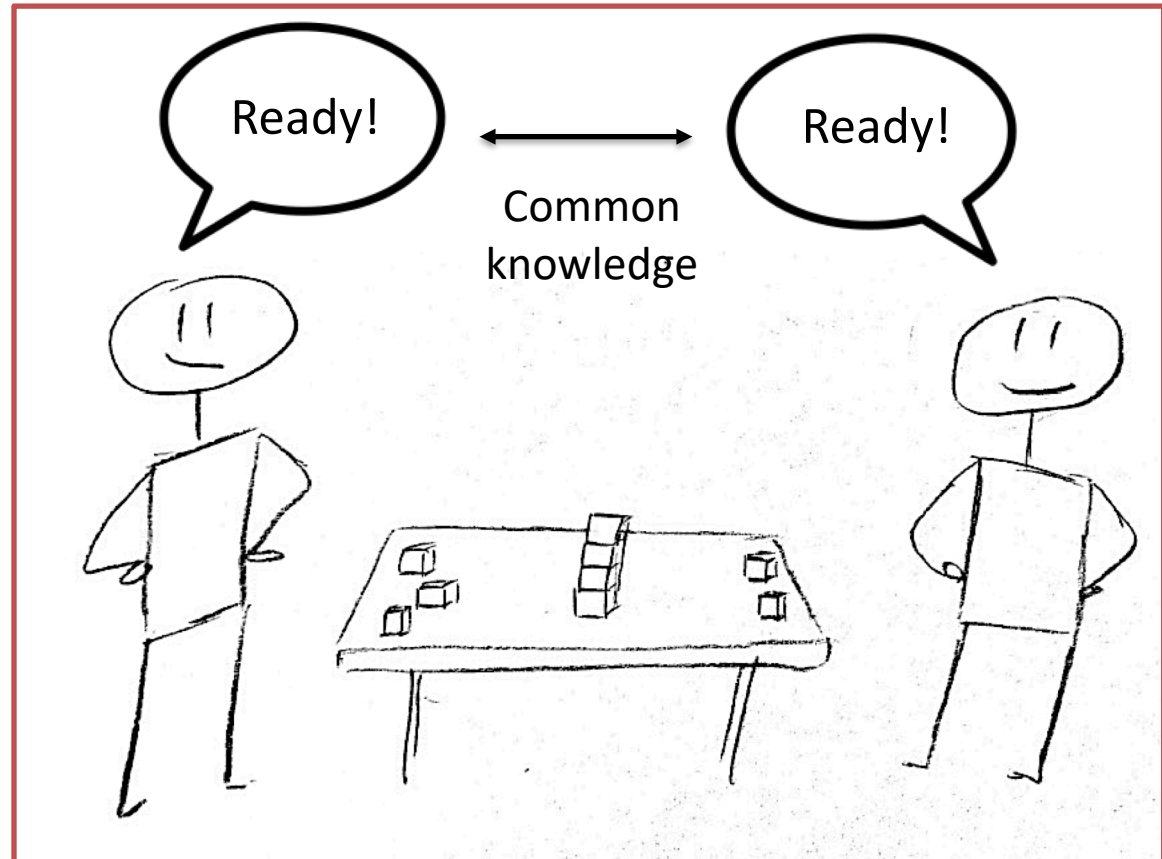
Joint commitment (to the joint activity) ¹⁹

- Mutual obligations and entitlements
- Express the readiness via Multimodal Communication



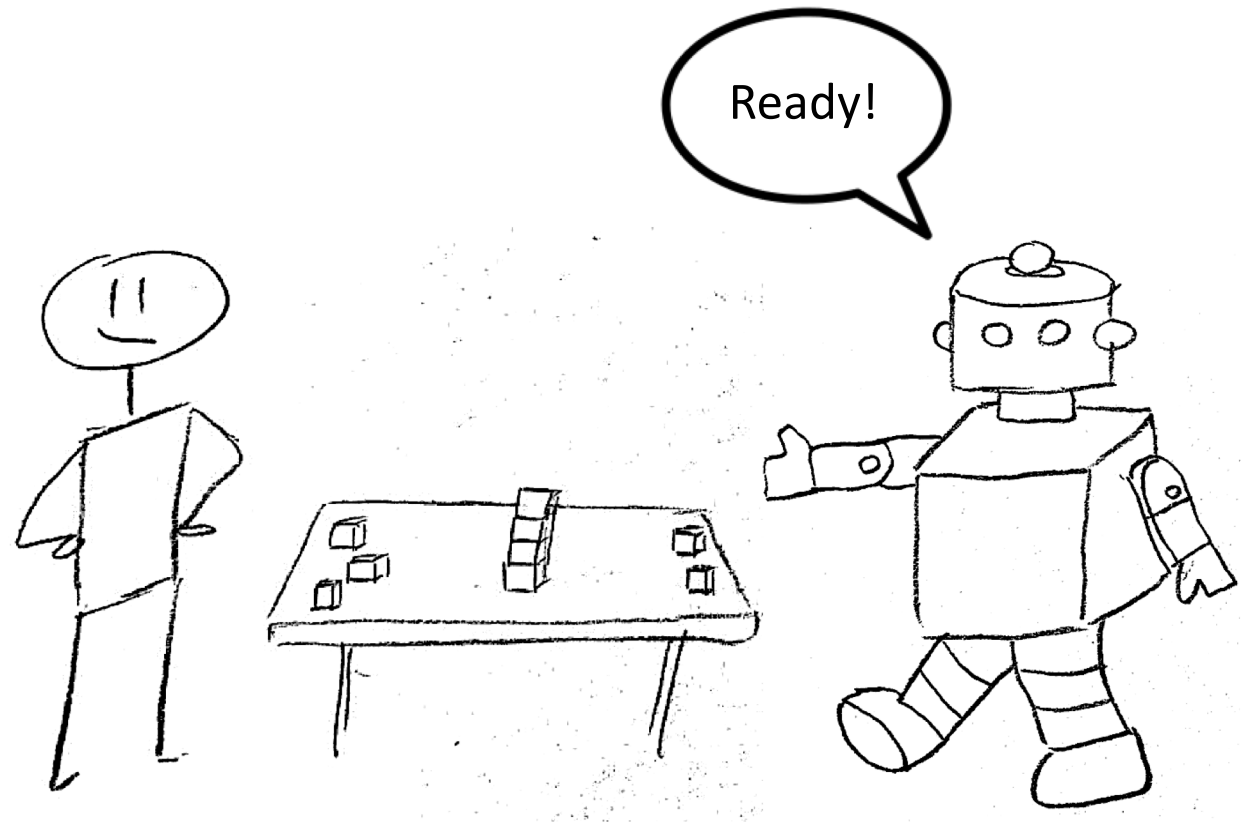
Joint commitment (to the joint activity) ²⁰

- Reduce uncertainty
- Make agents more predictable to one another
- Enhance coordination
- Generating and stabilizing expectations

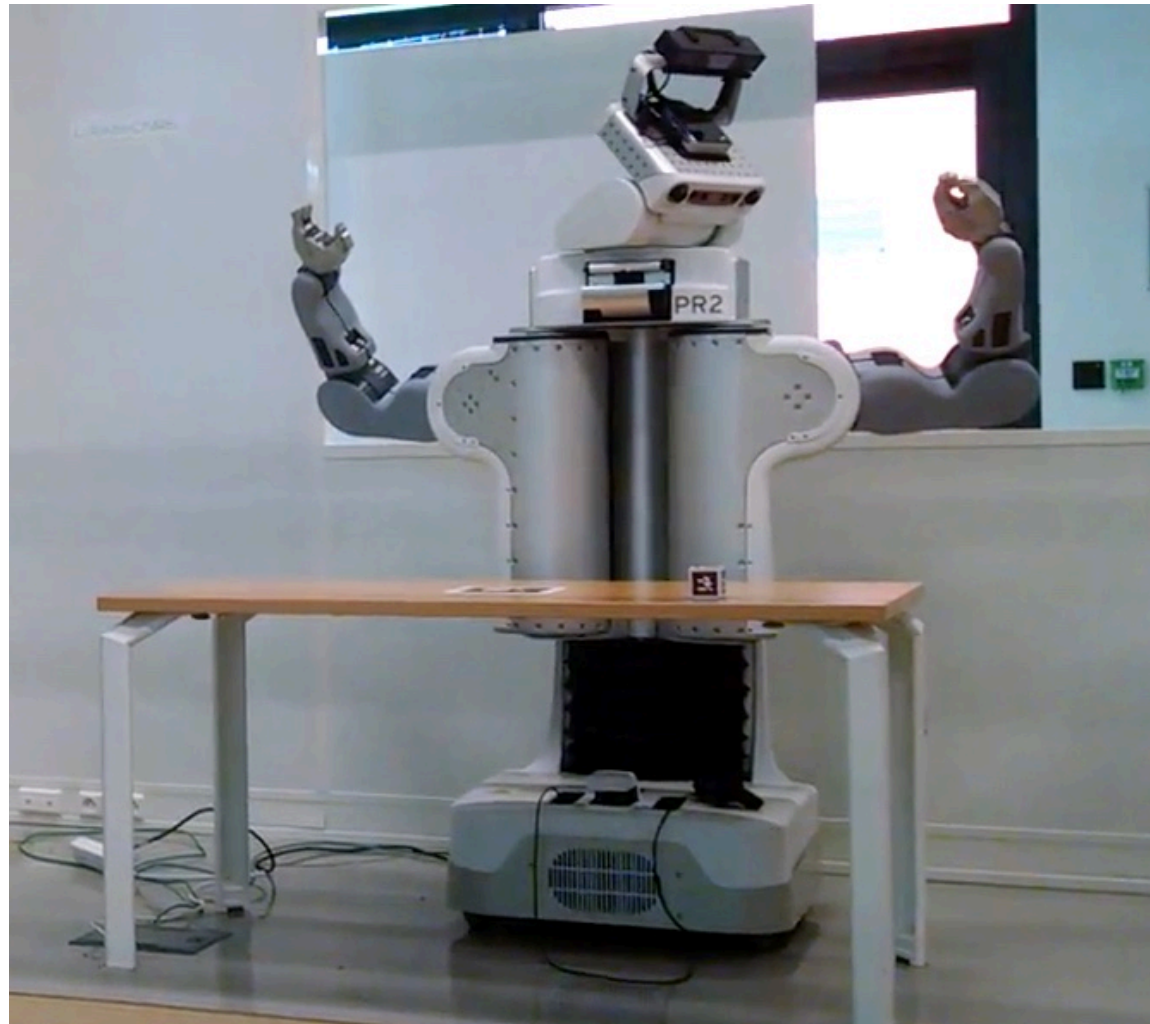


What about the robot?

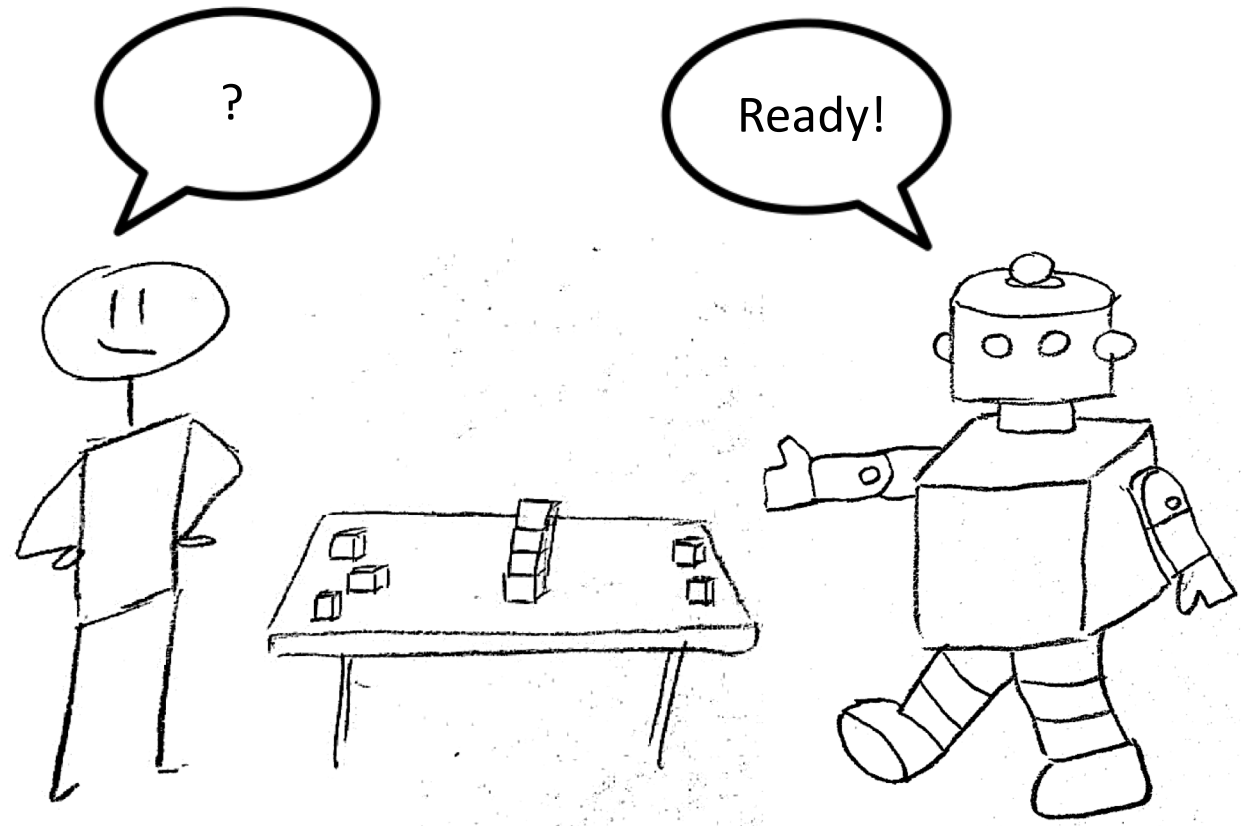
- Dialogue
- Positions
- Gazes



What about the robot?



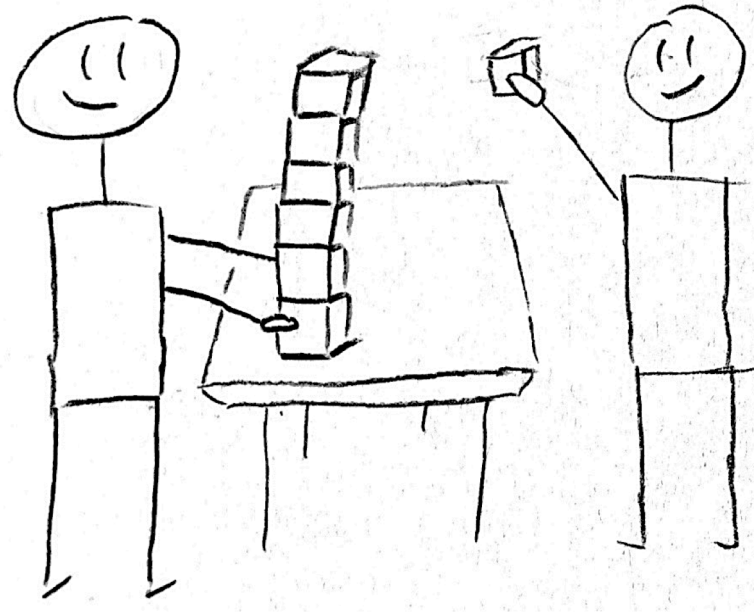
What about the robot?

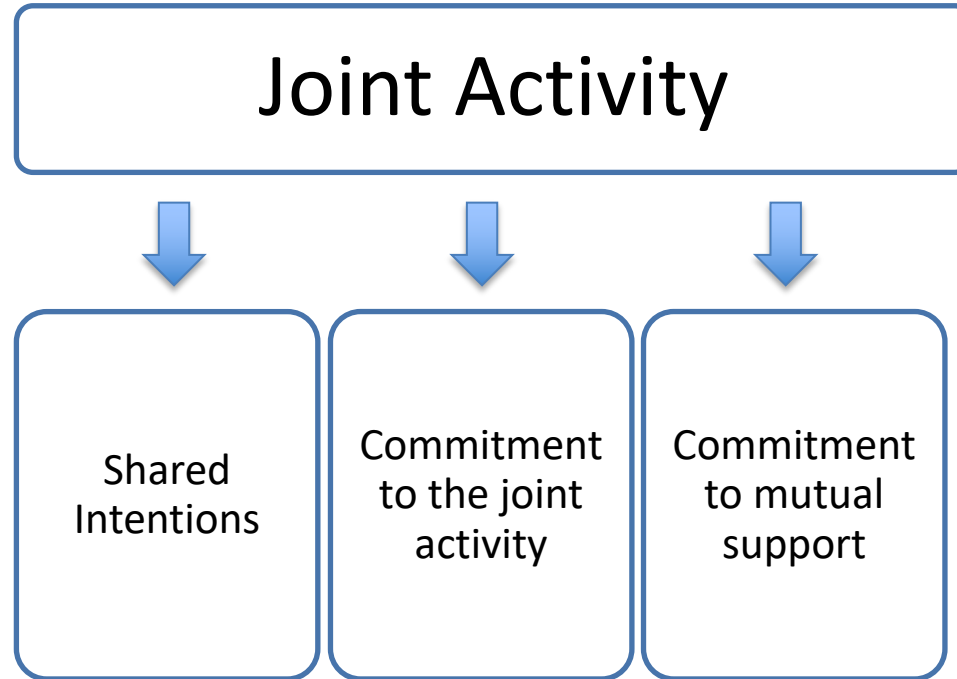


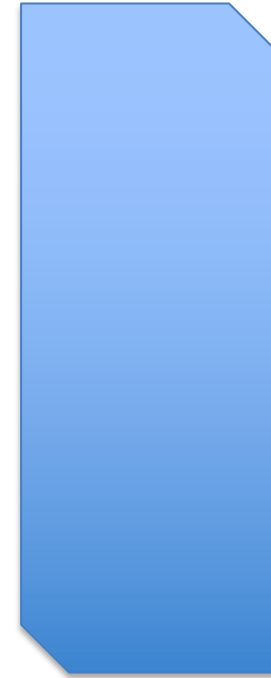
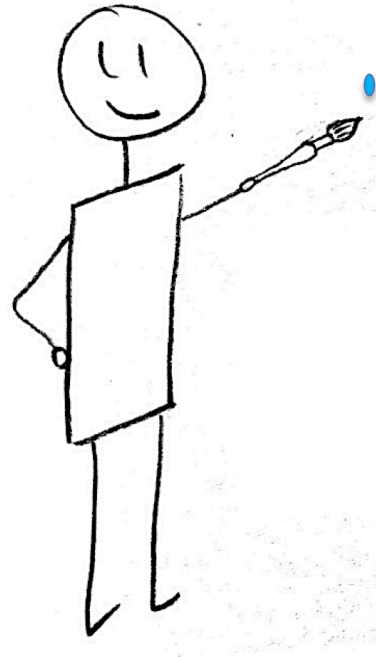
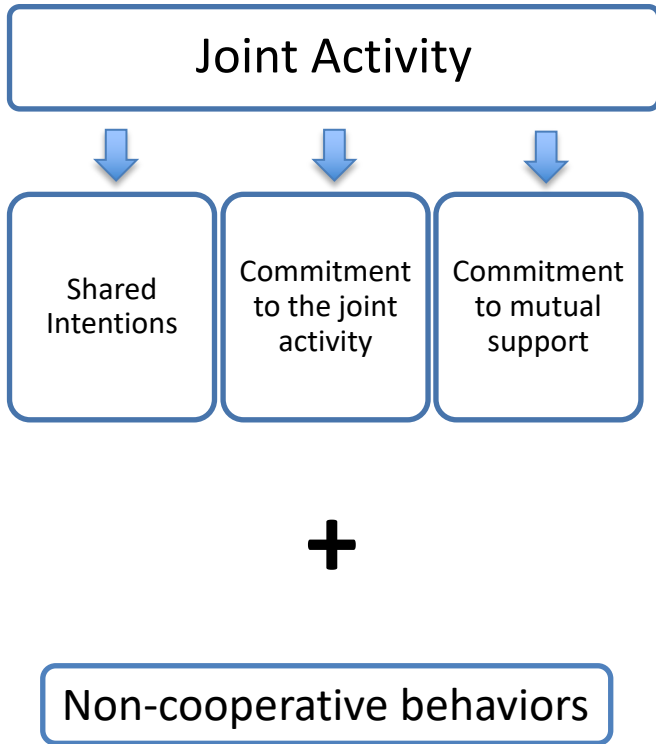
Commitment to mutual support

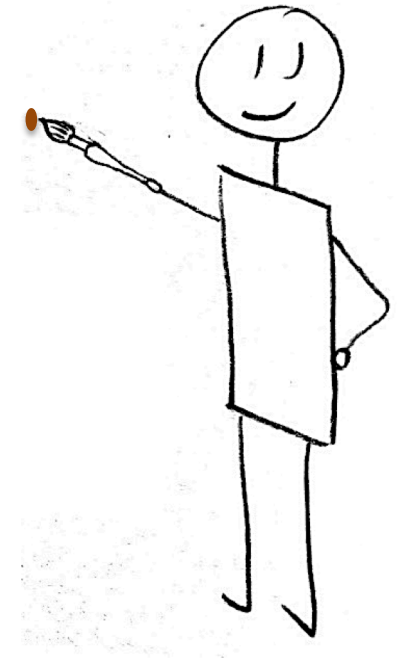
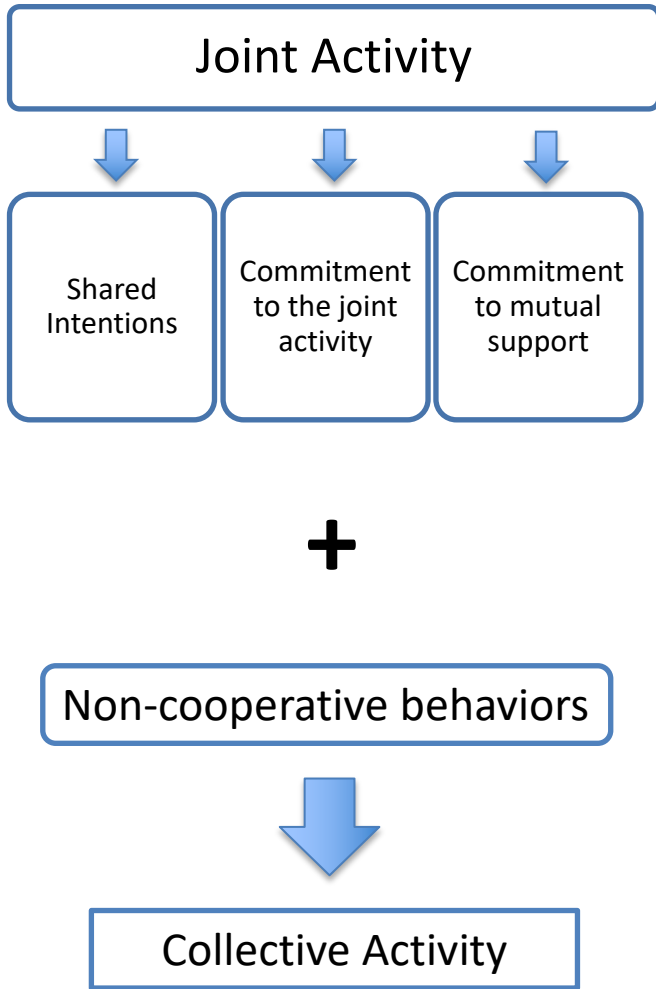
- Committed to supporting the efforts of the other

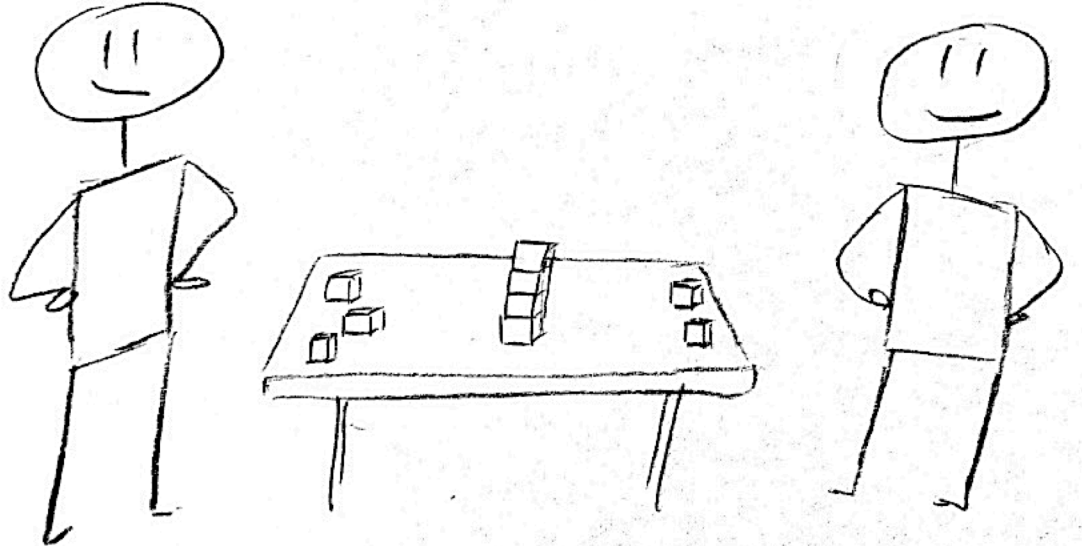
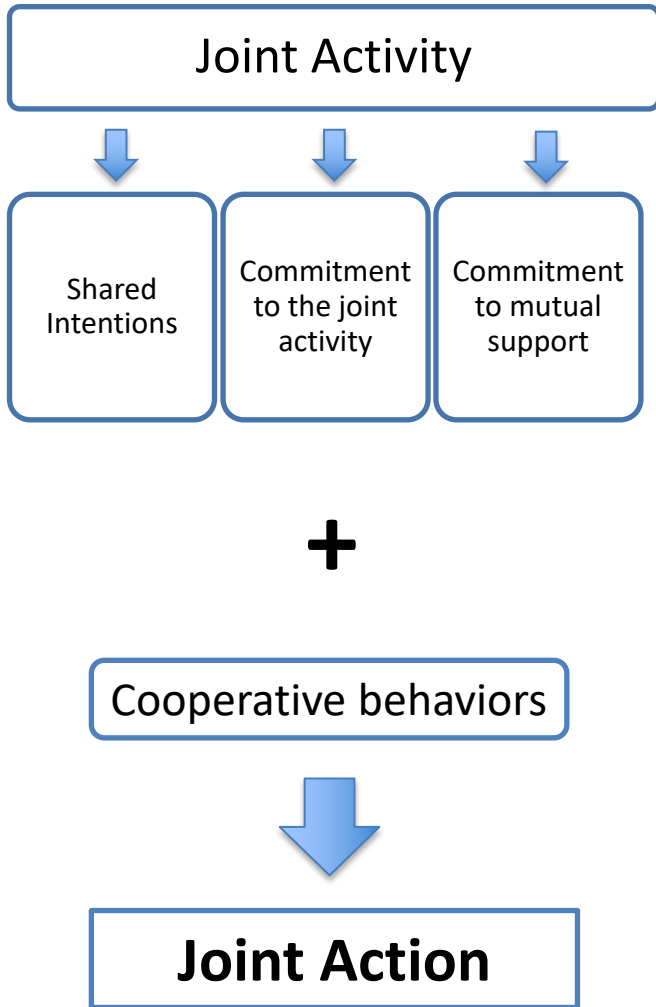
(Bratman, M.E. (1992). Shared Cooperative Activity. *The Philosophical Review*, 101(2), 327-341)







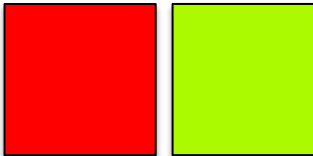
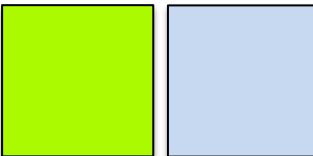
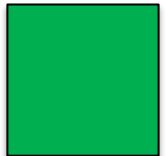
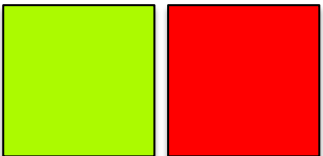
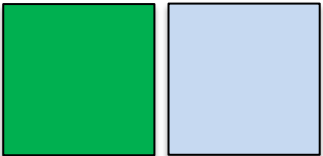
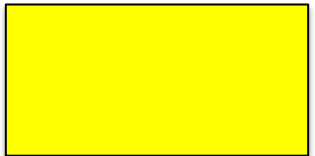
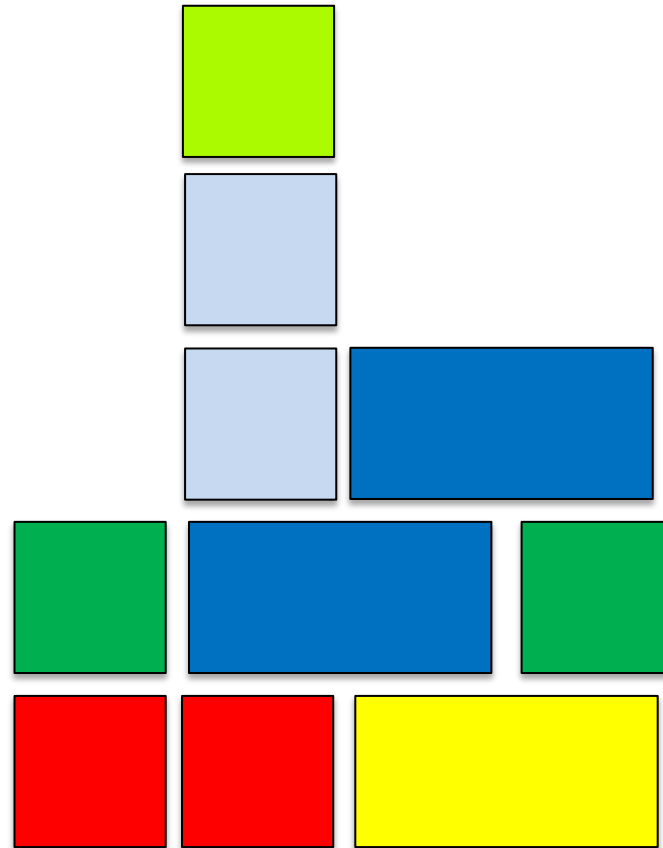




MODEL

Partner 1
cubes

Partner 2
cubes



Cooperative behaviors mechanisms

Joint Attention

Action Observation

Shared Representations

Action Coordination (in time and space)

Agency

(Sebanz, Bekkering & Knoblich, 2006)

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Joint Attention

« a triadic interaction in which two individuals coordinate attention to an object of mutual interest [...] in addition, it is crucial that both partners know together that they are attending to the same thing ».

(Carpenter & Call, 2013)

→ Perceptual common knowledge

Joint Attention

- Shared intentions and shared goals
- Readiness and commitment to the joint activity
- Coordination

Action Observation

Motor resonance

- Observation and action : common neural representation

(Gallese, Fadiga, Fogassi & Rizzolatti, 1996)

→ Understanding the actions, goals and intentions of others

(Rizzolatti & Sinigaglia, 2008)

→ Predicting the actions of others

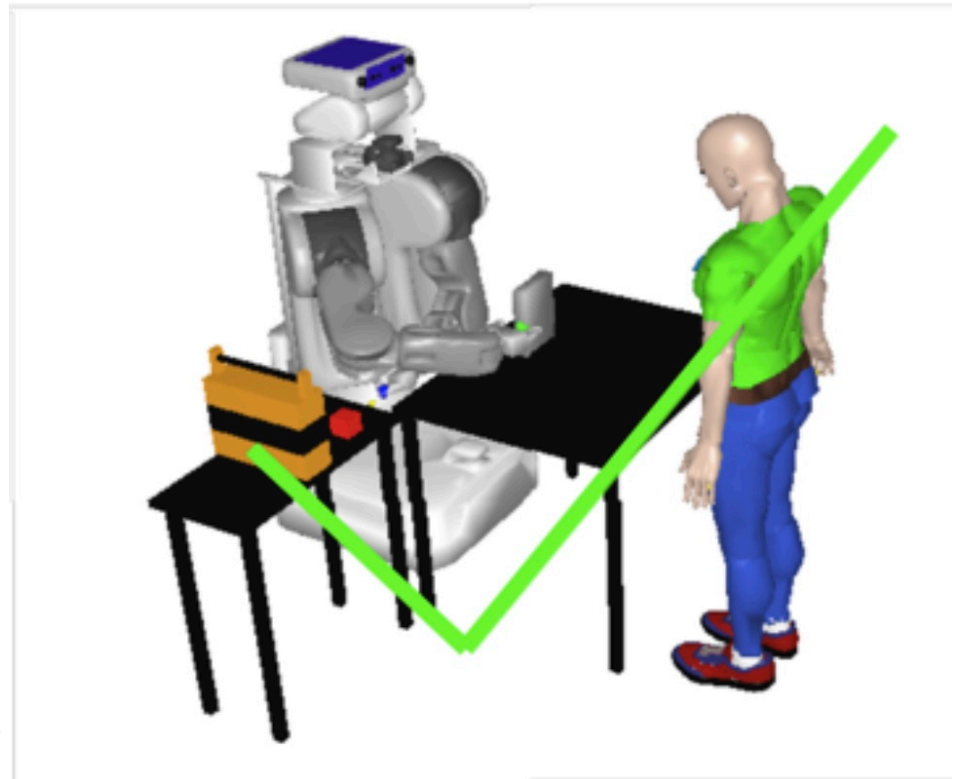
(Sebanz & Knoblich, 2009)

Action Observation

Motor resonance

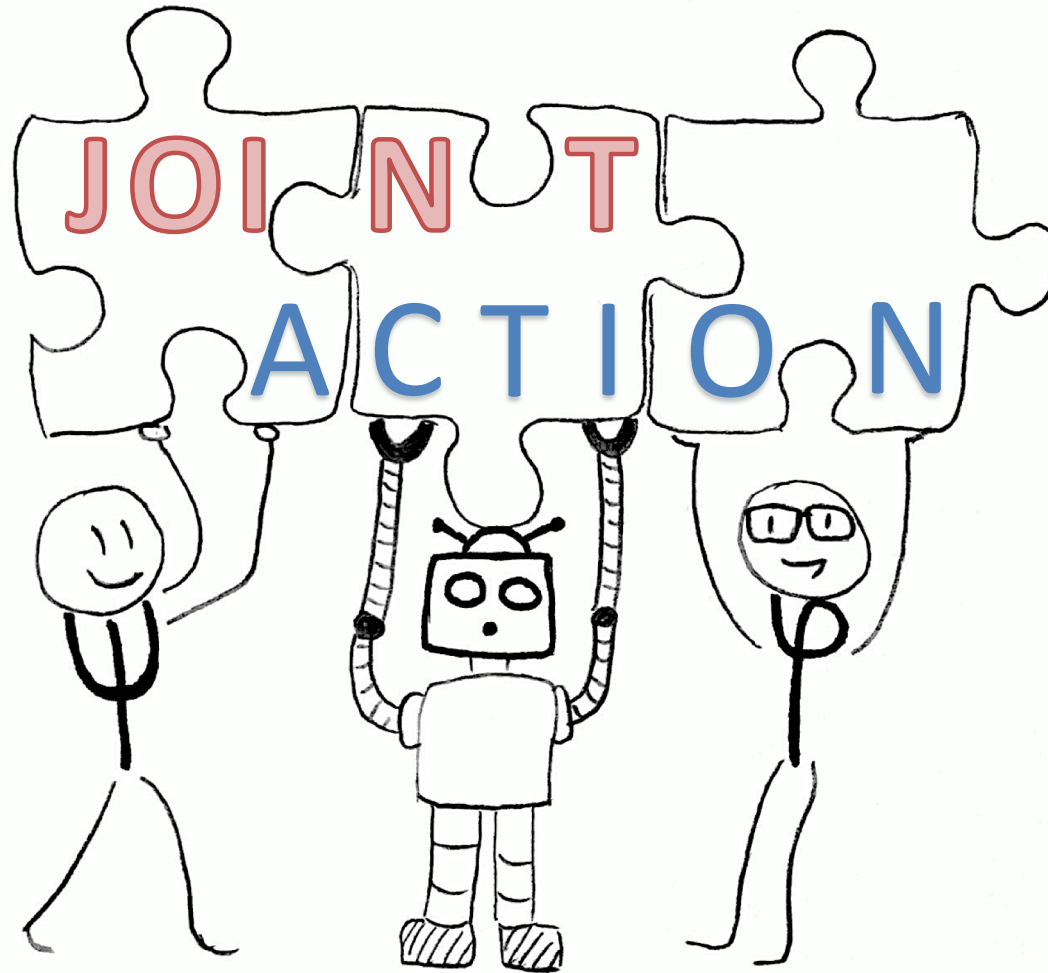
- Do not occur with robots?
(Kilner, Paulignan & Blakemore, 2003; Tai, Scherfler, Brooks, Sawamoto & Castiello, 2004)
- Or just because of non-biological motion?
(Bouquet, Gaurier, Shipley, Toussaint & Blandin, 2007)

Action Observation



Challenges

- Robot's communication about goals, actions, knowledge
- Robot's understanding of multimodal communication
- Better understand the essential components of joint actions and their stages and contexts of appearance in childhood



THANKS FOR YOUR ATTENTION