

Artificial Cognitive Systems

Module 9: Social Cognition

Lecture 1: Social interaction; action, goals, intention, attention

David Vernon
Carnegie Mellon University Africa

www.vernon.eu

Interaction

Cognition so far:

- Agent-centred
- “Lonely” activity
- Explore and interact with the world:
adaptation and autonomy
- Not collective social activity



<https://www.youtube.com/watch?v=AY-rnBoaiY8>

Interaction

- But ...

Other cognitive agents playing a major role in the cognitive activities of an individual cognitive agent

- Cognitive systems in a collective setting
 - How cognition in an individual agent takes place in a **social milieu**

Interaction

- Two of the essential characteristics of cognitive interaction
 - Action
 - Goals
- Two others
 - Intention
 - Perception

Interaction

Two of the essential characteristics of cognitive interaction

Intention ... the prospective aspect of action and goals

- **An intention includes both a goal and the means of achieving it**
- An agent may have
 - A goal for some state of affairs to exist and
 - An intention to do something specific in pursuit of that state of affairs

Interaction

Two of the essential characteristics of cognitive interaction

Perception

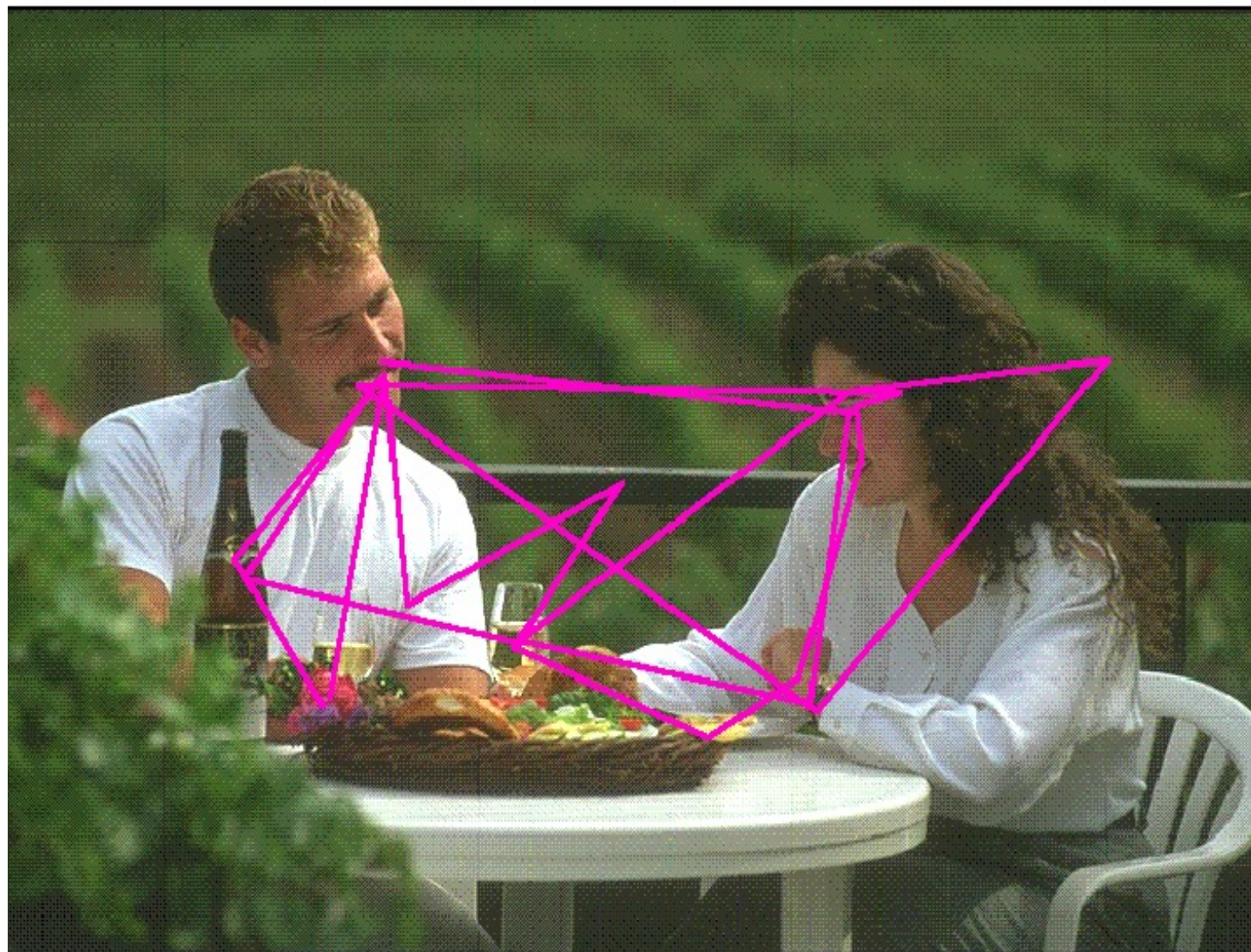
- Directed
- Focussed on goals
- Influenced by expectations
- **Attentive**

Interaction

Attention

- **Spatial** attention: where we direct our gaze
- **Selective** attention: what sort of things are most apparent to our gaze
- “the temporally-extended processes whereby an agent concentrates on some features of the environment to the (relative) exclusion of others.”

Kaplan and Hafner 2006



(K. O'Regan and A. Noë 2000)

Interaction

Attention

Intentionally-directed perception

We focus our attention on what matters to us in pursuit of our goals

“When performing movements or observing someone else performing them, **subjects fixate goals and sub-goals of the movements** [Johansson et al. 2001]. However, this is **only done if an action is implied**: when showing the same movements without the context of an agent, subjects fixate the moving object instead of the goal [Flanagan and Johansson 2003].”

Claes von Hofsten

(Simon & Chabris 1999)

Interaction

Attention

The video that follows has three cases:

1. an agent (the subject) stacks blocks
2. another agent (an actor) stacks blocks, and
3. a hidden agent (an actor with hidden hands) stacks blocks.

In cases 1 and 2, the subject's gaze **saccades to the goal position** in advance of the hand movement, i.e., it **predicts the intention** when it is an action (which requires the presence of an agent and a goal)

In case 3, the subject's gaze **just follows the block** because no agent is apparently present, and therefore **there is no intention**, no action, and no implied goal: it is just a movement

See: J. R. Flanagan, G. Rotman, A. F. Reichelt, and R. S. Johansson, "The role of observers' gaze behaviour when watching object manipulation tasks: predicting and evaluating the consequences of action," *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences*, vol. 368, no. 1628, 2013.

Block stacking

- ***subject performs***
- *actor performs*
- "*blocks just move*"
(*actors hand hidden*)

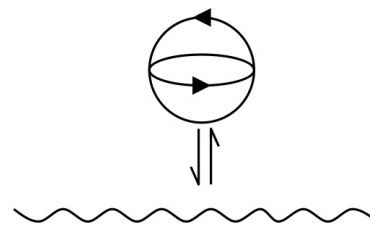
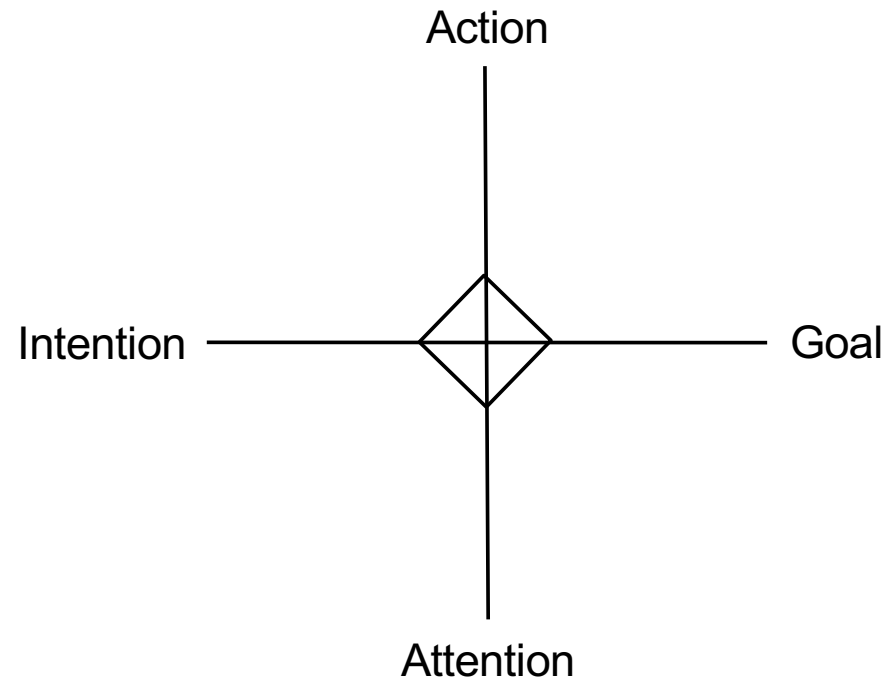


Interaction

4 characteristics **of interaction of an individual** cognitive agent

1. **Action**
2. **Goals** (or commitment)
3. **Intention**
4. **Attention** (intention-guided perception)

All of which have an element of prospection

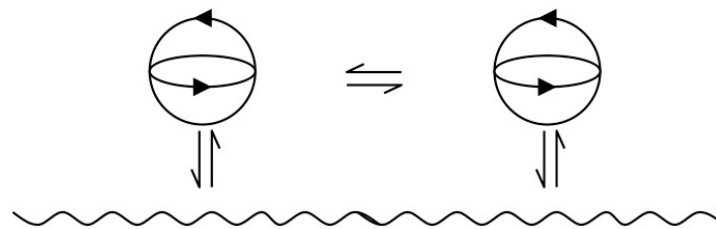
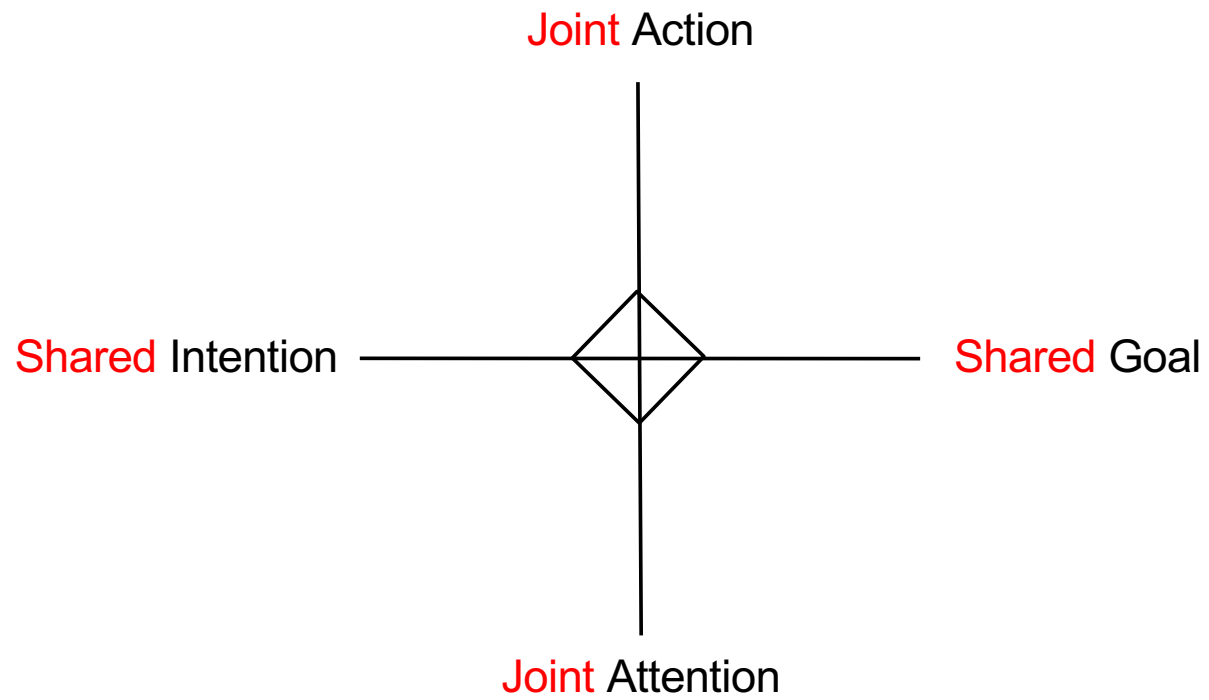


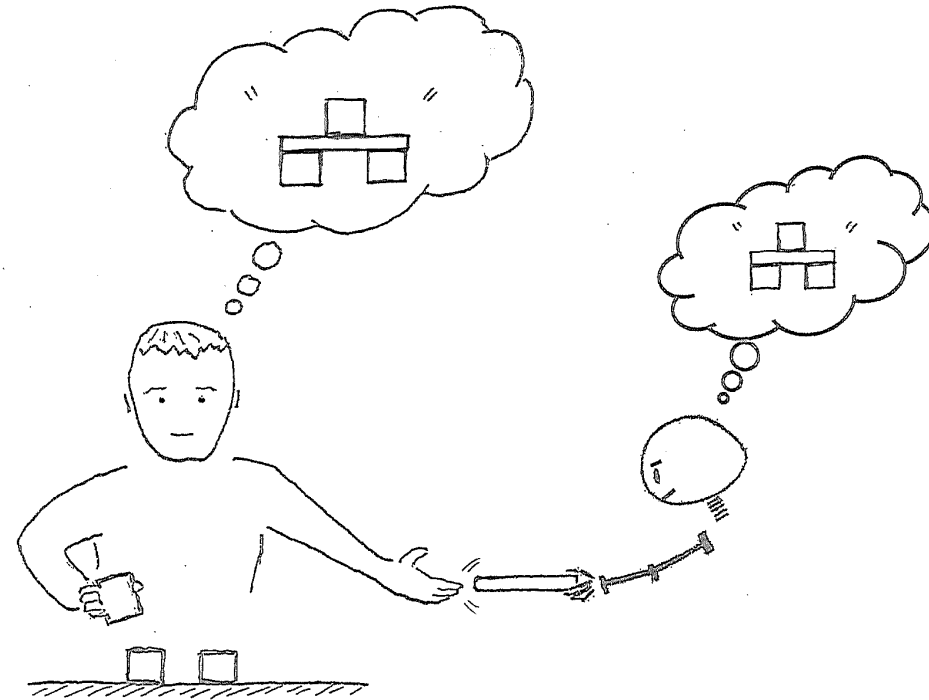
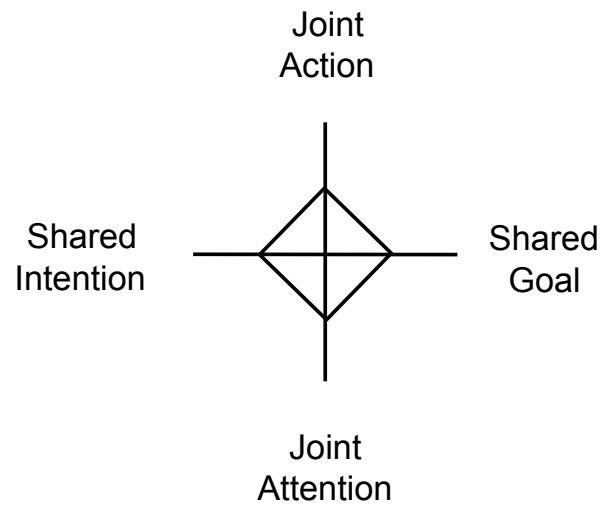
Interaction

Social interaction between two (or more) cognitive agents

1. **Joint** action
2. **Shared** goals
3. **Shared** intentions
4. **Joint** attention

Not just a simple superposition of the notions of individual action, goals, intentionality, and attention





Social Interaction

Required abilities

- Reading faces
- Detecting eye gaze
- Recognizing emotional expressions
- Perceiving biological motion
- Paying joint attention
- Detecting goal-directed actions
- Discerning agency, imitation, deception, empathy, ...

- ...

- **Need to be aware of the cognitive state of the other agent**

Social Interaction

- There is a link between the state of an agent's body and its cognitive & affective state
- Four aspects to this link:
 1. When an agent perceives a social stimulus, this perception produces bodily states in the perceiving agent

Social Interaction

- There is a link between the state of an agent's body and its cognitive & affective state
- Four aspects to this link:
 1. The perception of bodily states in other agents frequently evokes a tendency to mimic those states
 2. The perception of bodily states in other agents frequently evokes a tendency to mimic those states

Social Interaction

- There is a link between the state of an agent's body and its cognitive & affective state
- Four aspects to this link:
 1. The agent's own body states trigger cognitive states in the agent
 2. The agent's own body states trigger affective states in the agent
 3. The agent's own body states trigger affective states in the agent
 4. The agent's own body states trigger cognitive states in the agent

Social Interaction

- There is a link between the state of an agent's body and its cognitive & affective state
- Four aspects to this link:
 1. The efficiency of an agent's physical and cognitive performance is strongly affected by the compatibility between its bodily states and its cognitive states
 2. The efficiency of an agent's physical and cognitive performance is strongly affected by the compatibility between its affective states and its cognitive states
 3. The efficiency of an agent's physical and cognitive performance is strongly affected by the compatibility between its bodily states and its affective states
 4. The efficiency of an agent's physical and cognitive performance is strongly affected by the compatibility between its bodily states and its cognitive states

Social Interaction

The posture, movements, and actions of an agent

- Convey a great deal about its cognitive and affective disposition
- As well as influencing how another agent will behave towards it

Reading

Vernon, D. *Artificial Cognitive Systems – A Primer*, MIT Press, 2014; Chapter 9.