Artificial Cognitive Systems

Module 7: Memory and Prospection

Lecture 2: Self-projection, prospection, and internal simulation

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Self-Projection, Prospection, & Internal Simulation

Memory plays at least four roles in cognition

1. Remember past events
2. Anticipate future ones
3. Imagine the viewpoint of other people
4. Navigate around our world

Self-Projection, Prospection, & Internal Simulation

All four roles involve **self-projection**

- Ability of an agent to shift perspective from itself in the here-and-now
- It does this by **internal simulation**,
  - i.e. the mental construction of an imagined alternative perspective

Self-Projection, Prospection, & Internal Simulation

There are four forms of internal simulation

1. **Recalling episodic memories** (remembering the past)
2. **Navigation** (orienting yourself topographically, i.e. in relation to your **present** surroundings)
3. **Theory of mind** (taking someone else's perspective on matters)
4. **Prospection** (anticipating possible future events)

Self-Projection, Prospection, & Internal Simulation

- Each form of simulation has a different orientation
  - Past
  - Present
  - Future
- Each refers to the perspective of either the first person
  - The agent itself
  - Another person

Self-Projection, Prospection, & Internal Simulation

- All four forms of simulation are **constructive**
  - They involve a form of **imagination**
- Fine for prospection, theory of mind, or navigation
- But remembering the past? … more on this in a moment

Self-Projection, Prospection, & Internal Simulation

- There is a difference between **knowing about the future** and **projecting ourselves into the future**
- Projection is experiential, knowing is not
- Episodic memory (memory of experiences) and semantic memory (memory of facts) facilitate different types of prospection

Self-Projection, Prospection, & Internal Simulation

- Episodic memory
  - **Re-experience** your past
  - **Pre-experience** your future
- Projecting yourself forward in time is important when you form a goal
  - Creating a mental image of yourself acting out the event
  - **Episodically pre-experiencing** the unfolding of a plan to achieve that goal
  - **Episodic Future Thinking** [Atance and O'Neill 2001]

Self-Projection, Prospection, & Internal Simulation

Episodic memory is inherently constructive

- Old episodic memories are reconstructed slightly differently every time a new episodic memory is assimilated or remembered

- The constructive episodic simulation hypothesis (Schacter and Addis 2007)

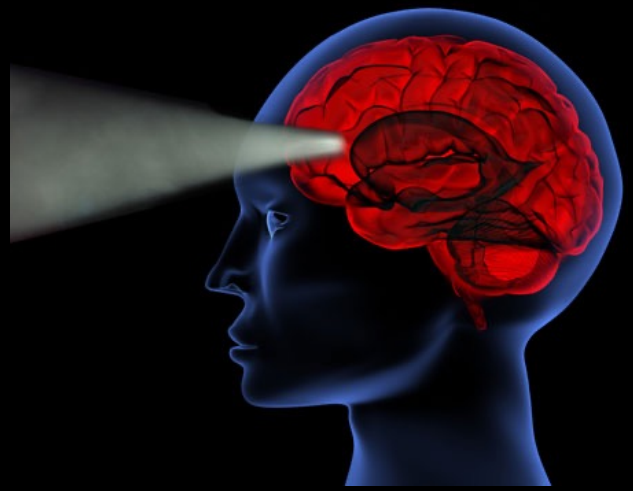
  - Episodic memory allows the **simulation of multiple possible futures**

  - This imposes an **even greater** need for a constructive capacity because of the need to extrapolate **beyond past experiences**

Episodic Memory

Specific instances of
the agent's experience

The Past



Past events are
reconstructed ...

Episodic Memory

The Past

The Future

Past events are
reconstructed ...

To allow the agent
to **pre-experience** the future

Episodic Future Thinking

The Past

The Future

Past events are
reconstructed ...

To allow the agent
to **pre-experience** the future

C. M. Atance and D. K. O'Neill, "Episodic future thinking," Trends in Cognitive Sciences, vol. 5, no. 12, pp. 533–539, 2001.

The constructive episodic simulation hypothesis

The Past

Future A
Future B
Future C
...

Past events are **reconstructed ...**

To allow the agent to **pre-experience** the future

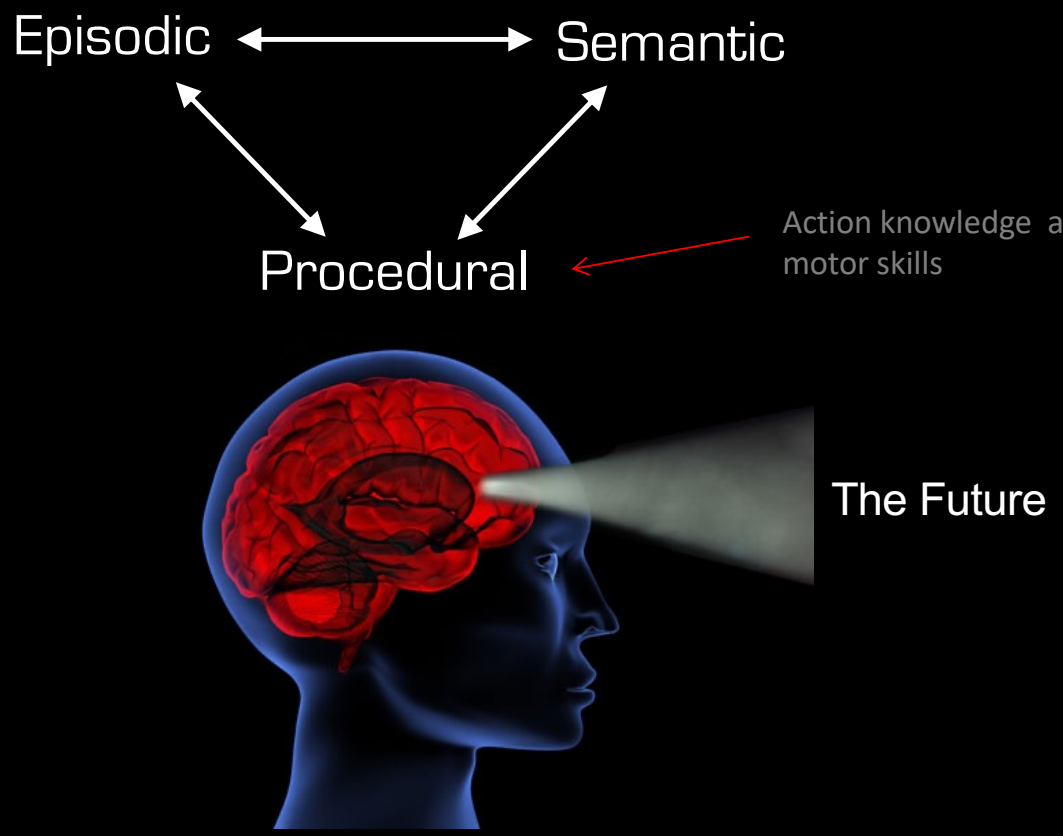
D. L. Schacter and D. R. Addis, "The cognitive neuroscience of constructive memory: Remembering the past and imagining the future," Philosophical Transactions of the Royal Society B, vol. 362, pp. 773–786, 2007.

Episodic ⟷ Semantic

General knowledge
about the agent's world

The Future

K. K. Szpunar, R. N. Spreng, and D. L. Schacter, A taxonomy of prospection: introducing an organizational framework for future-oriented cognition, PNAS 111(52), 18414–18421, 2014.



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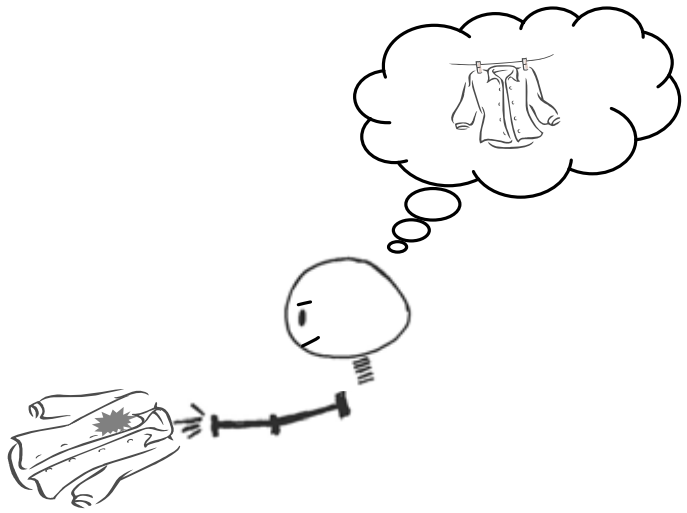

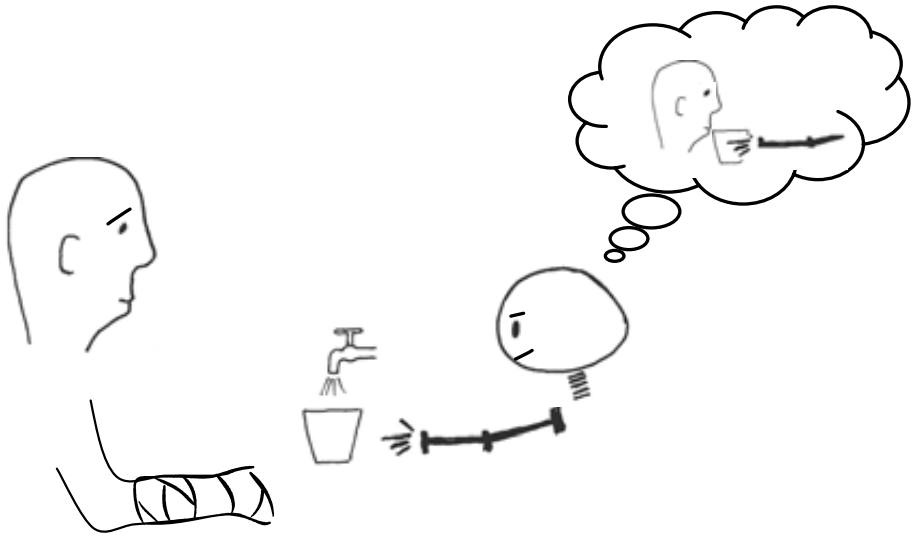

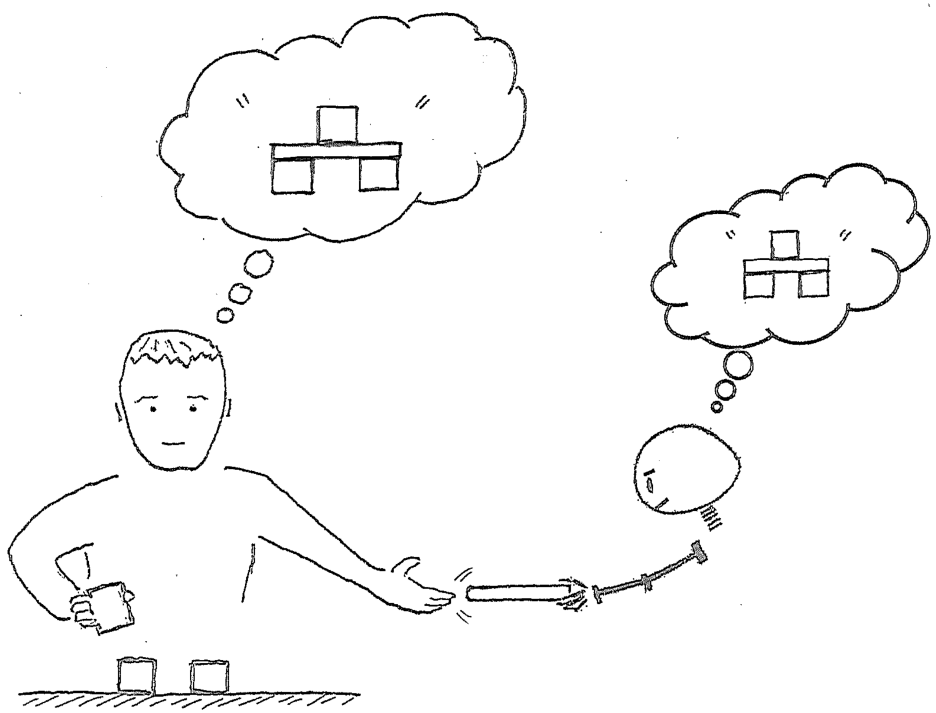

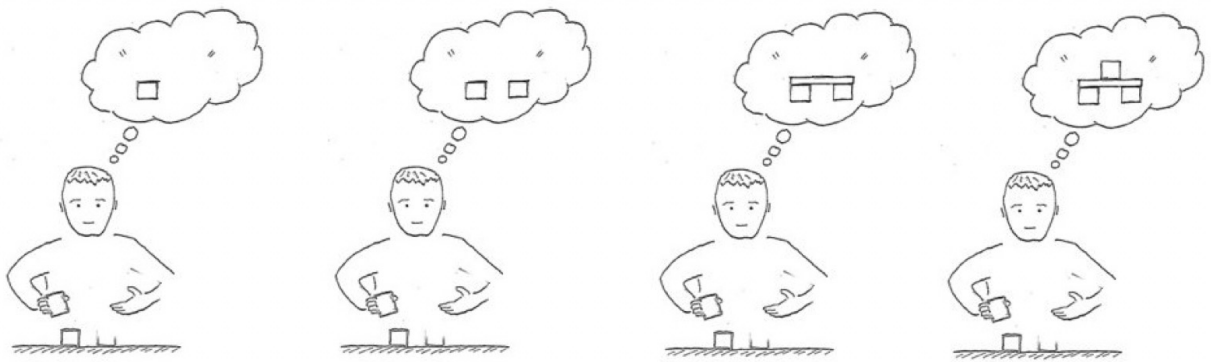

The Future

Self-Projection, Prospection, & Internal Simulation

- Episodic memory is not an exact and perfect record of experience
- It captures the essence of an event and is open to recombination

Self-Projection, Prospection, & Internal Simulation

- When humans imagine the future
  - They anticipate an event
  - They anticipate how they feel about that event
- Knowing how you feel about something is a very good way of telling whether or not that event is safe or dangerous
- We call these the hedonic consequences of the event
- Pre-experience of prospection also involves pre-feeling

Self-Projection, Prospection, & Internal Simulation

- Pre-feeling is not always reliable
  - Current context also play a part
- Many of the errors are due to inadequacies in the simulation
- There are four types of problems with simulation in humans

Self-Projection, Prospection, & Internal Simulation

1. Simulations can be unrepresentative

   We often use an extreme memory of a past event (either bad or good) to imagine such an event in the future

Self-Projection, Prospection, & Internal Simulation

2. Simulations are based on memories that retain only the essentials of the event

- But non-essential elements often have a significant impact on subsequent hedonic experience
- People tend to predict that
  - good events will be better in the future
  - bad events will be worse.

Self-Projection, Prospection, & Internal Simulation

3. Simulations are abbreviated and are focussed on the early aspects of an event:

   - Over-emphasize the initial moments of the event

   - Under-estimate how quickly we adapt and therefore don't represent how we will actually feel about an event

Self-Projection, Prospection, & Internal Simulation

4. Simulations are decontextualized

They don't reflect the contextual conditions that can have a significant impact on hedonic experience

Self-Projection, Prospection, & Internal Simulation

- Why are we spending so much time discussing feeling in a lecture devoted to cognition?

- The reason is that feeling — affect or emotion — plays a pivotal role in cognitive behaviour

  - Influencing the decisions we make
  - Impacting the actions we select

- Cognition is **not** just about rational analysis

  - It is as much about acting effectively

Reading

Vernon, D. Artificial Cognitive Systems – A Primer, MIT Press, 2014; Chapter 7.