Memory and Consciousness

Christine Bastin

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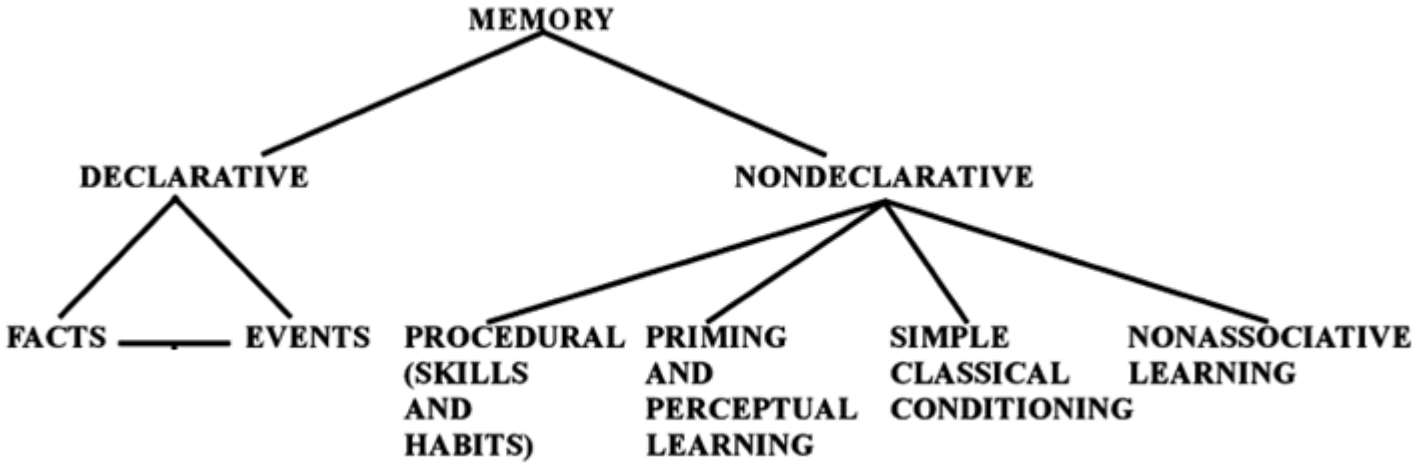
Overview

1. Systems of memory and their relationships to consciousness
2. Mental time travel and construction of identity
3. Metacognition

1. Systems of memory

Short-term memory

Long-term memory



Squire et al. (2004)

1. Systems of memory

Short-term memory: to briefly maintain a small amount of information

To retain a phone number while dialing

To make mental calculation

To take notes during a speech

To remember what we just wrote/read in a text

To remember what we were going to pick up in a room

1. Systems of memory

Episodic memory: to remember personally experienced past events

What did I do yesterday?

Where and when did that happen?

Autobiographical memories

Who told me that?

1. Systems of memory

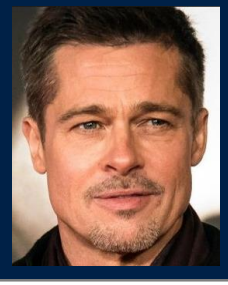
Semantic memory: Knowledge about the world

What is the capital city of Russia?

What must I do when I go to the restaurant?

What means « stamp »?

What is this person famous for?



1. Systems of memory

Procedural memory: Know-how

Typing

To play the piano

To swim

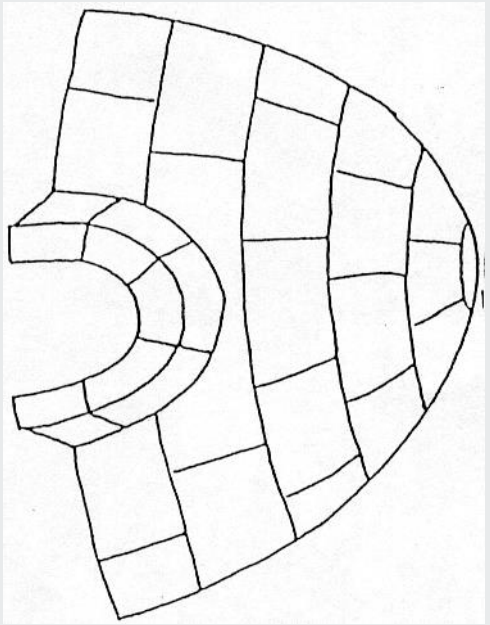
To use of tool

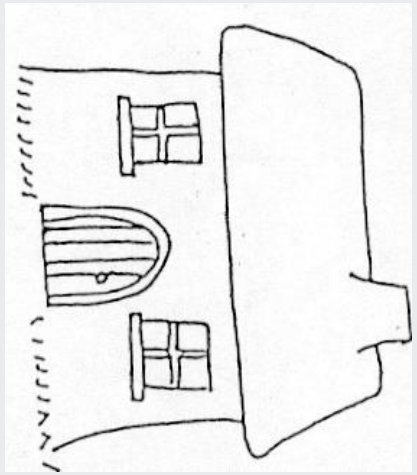
To drive a car

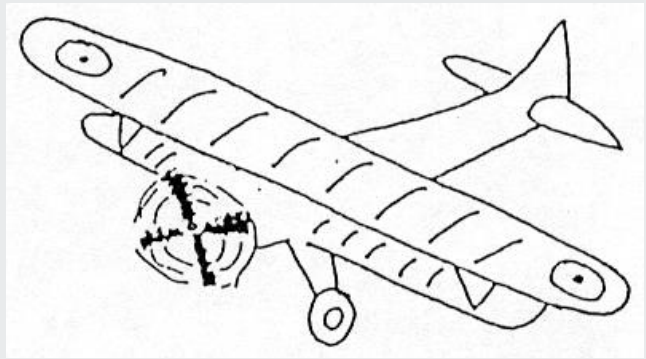
Maths skills

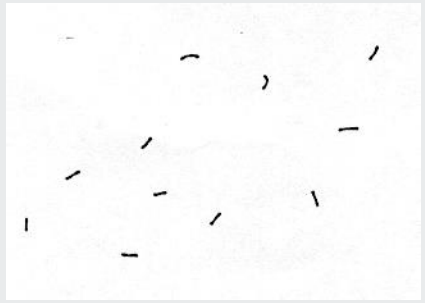
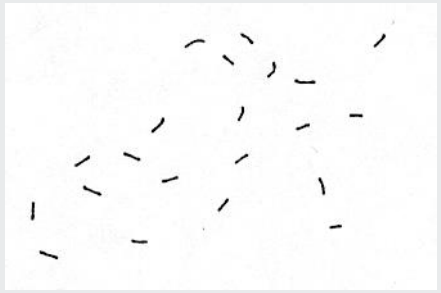
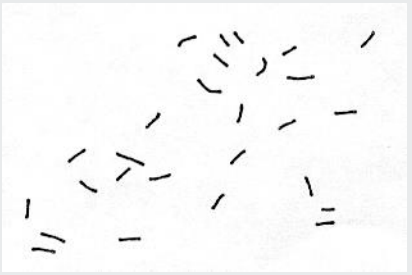
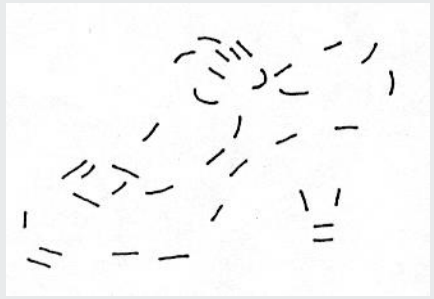
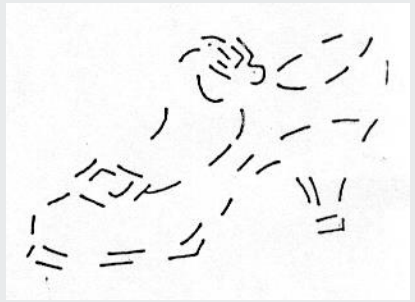
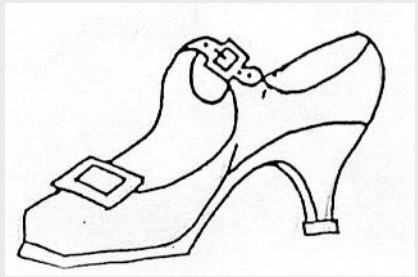
1. Systems of memory

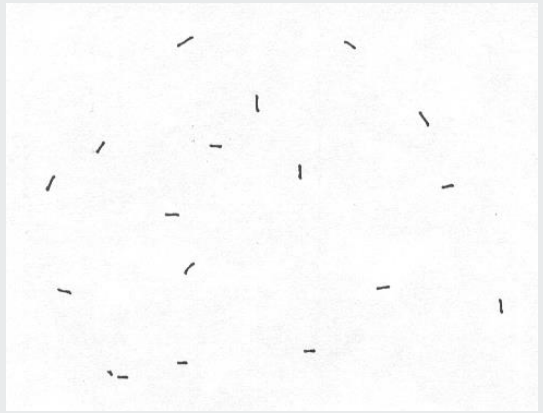
Priming (Perceptual Representation systems): To store the shape of words, objects, faces…

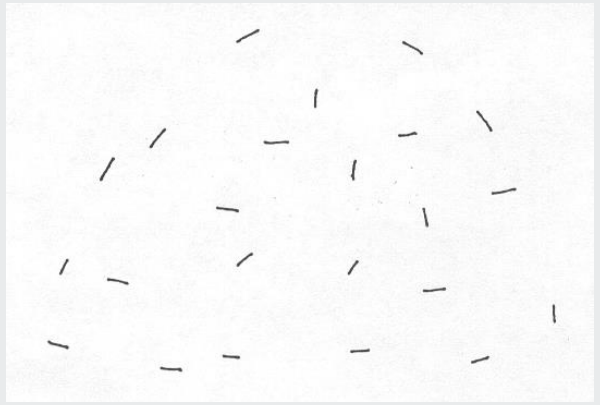


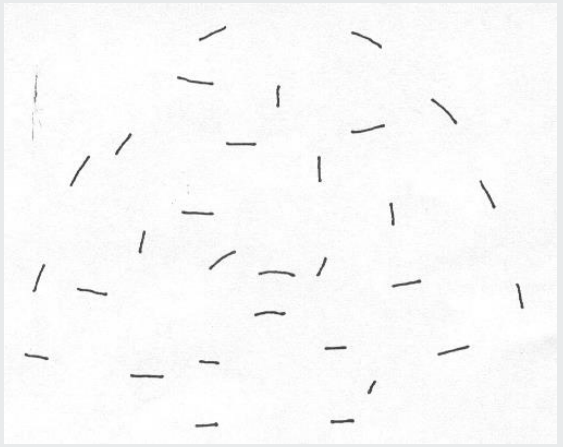


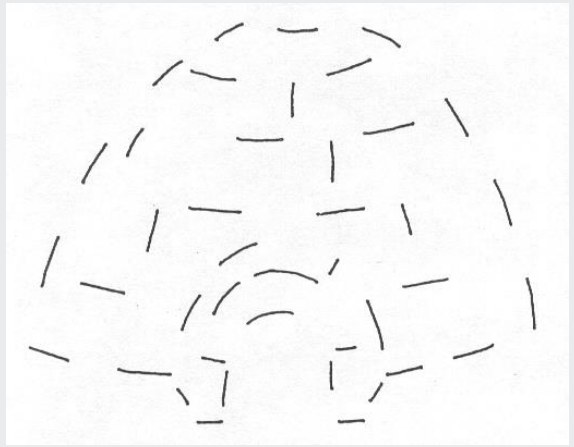


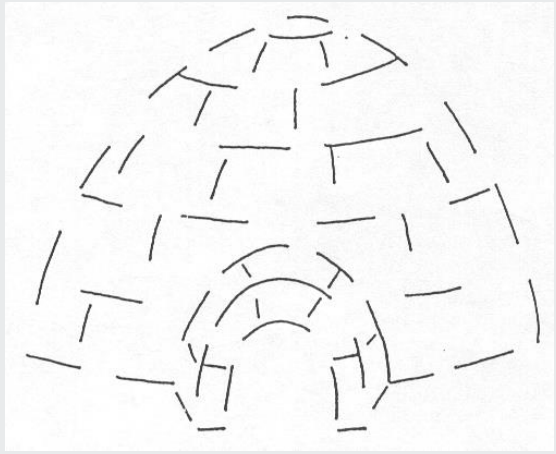







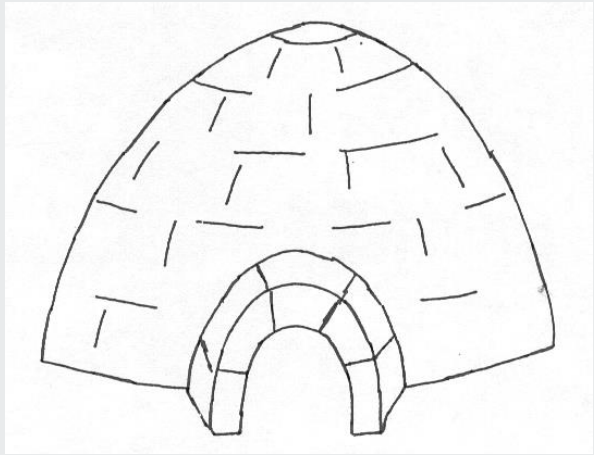


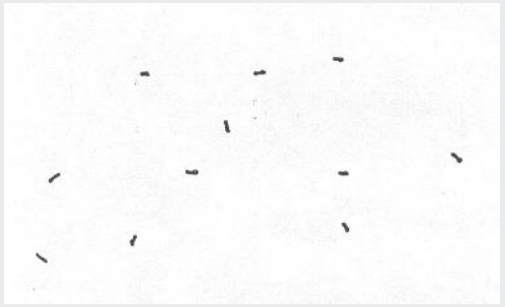


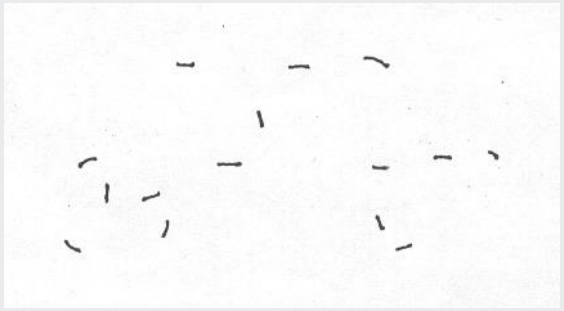


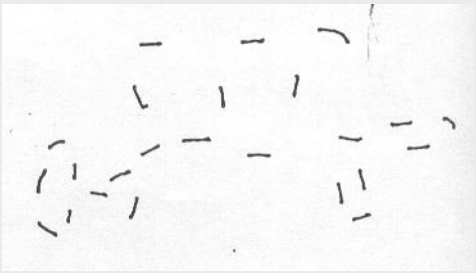


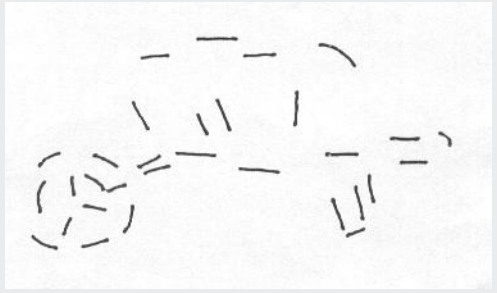


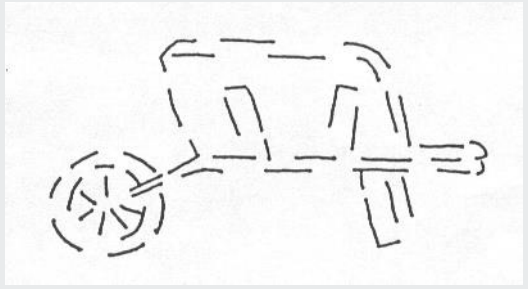


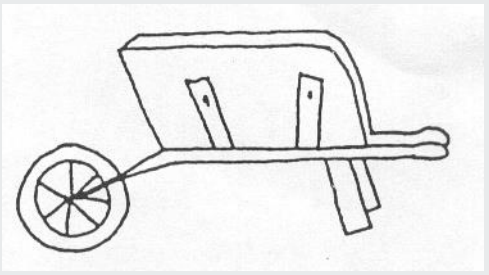


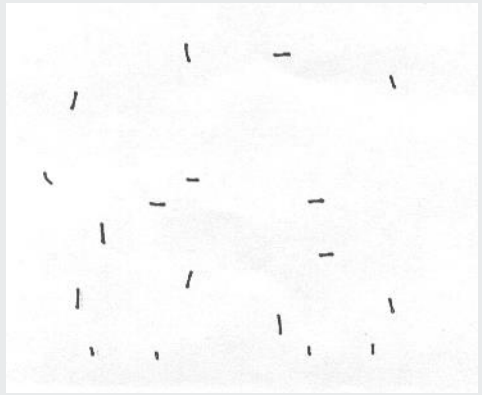
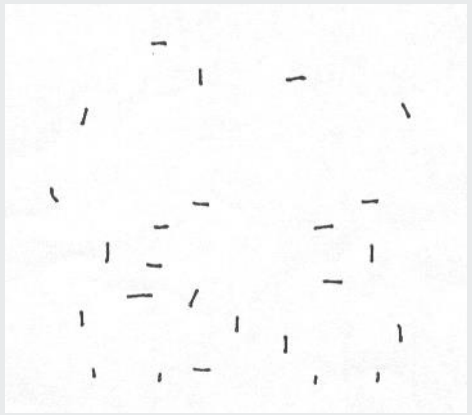
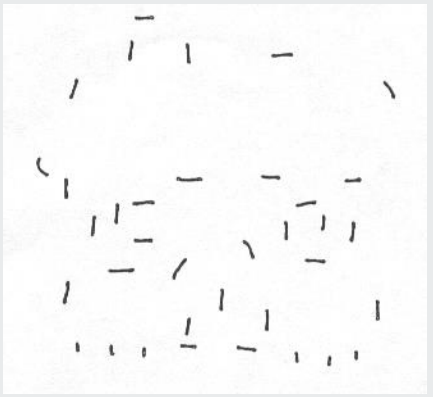
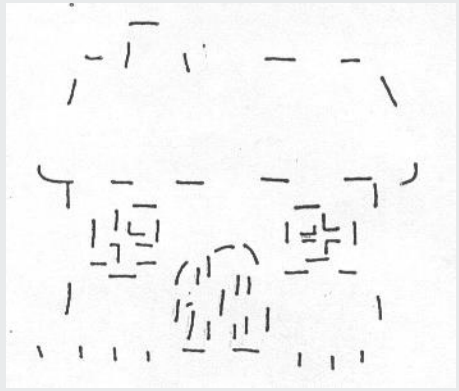






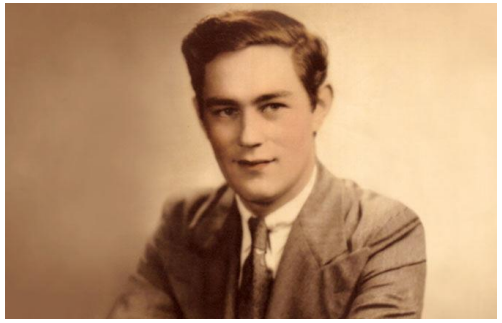




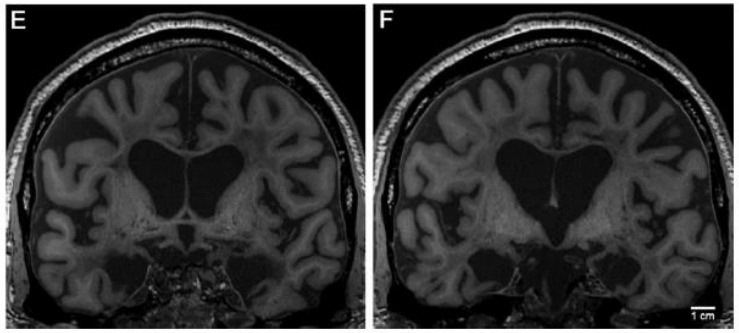





1. Systems of memory

How do we know that there are independent memory systems?



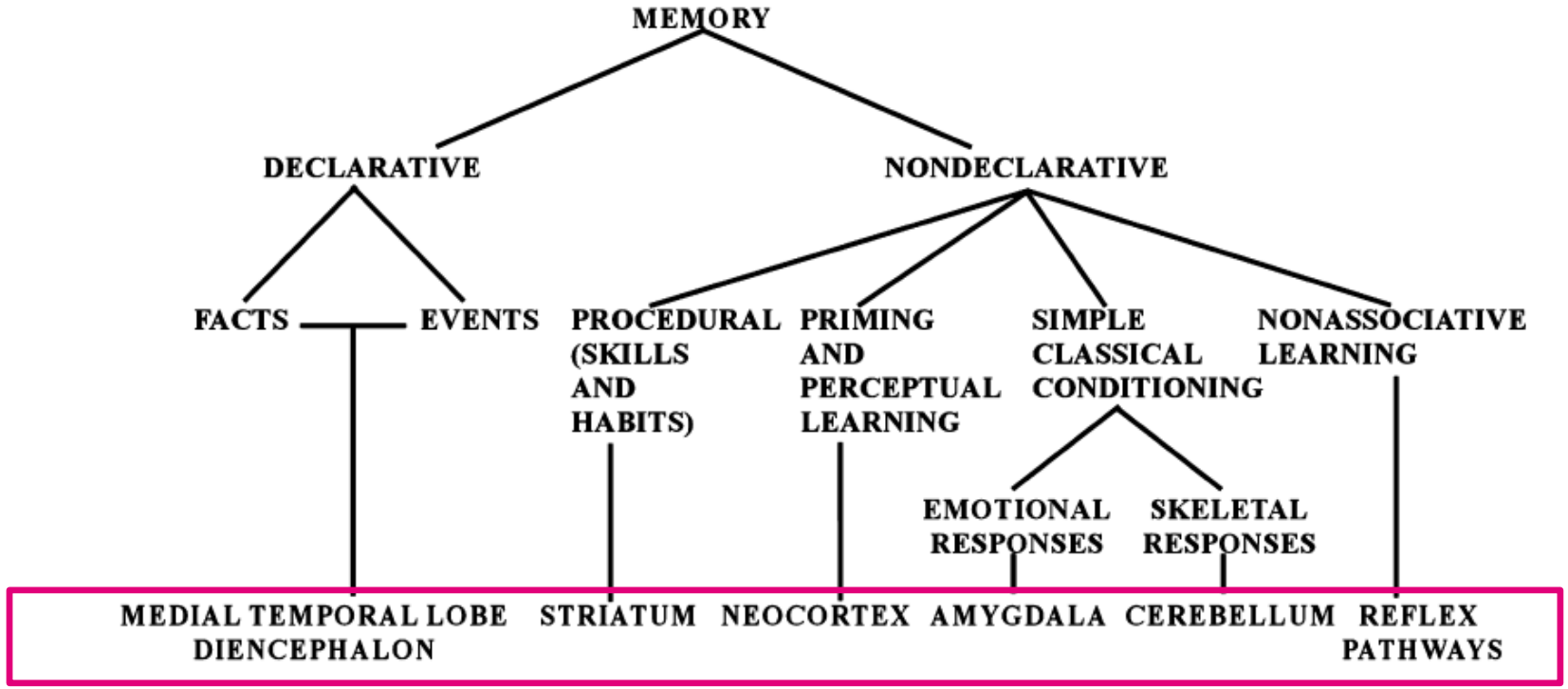
H.M.



Impaired	Intact
Learning of new facts and events	Short-term memory
Retrograde amnesia limited to most recent memories	Procedural memory
	Priming

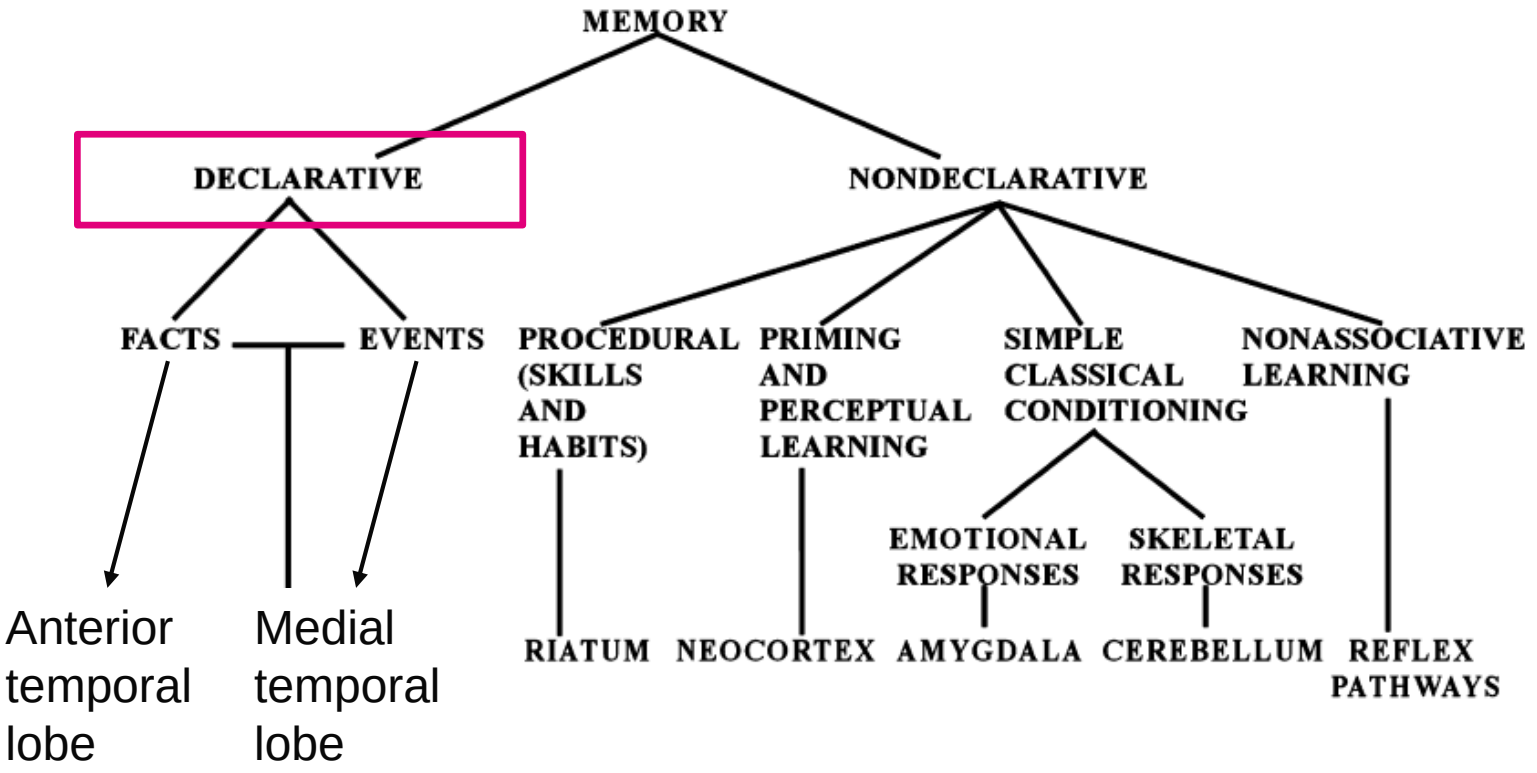
Scoville WB, Milner B. 1957. Loss of recent memory after bilateral hippocampal lesions. J Neurol Neurosurg Psychiatry 20:11–21.

1. Systems of memory



Squire et al. (2004)

1. Systems of memory



1. Systems of memory

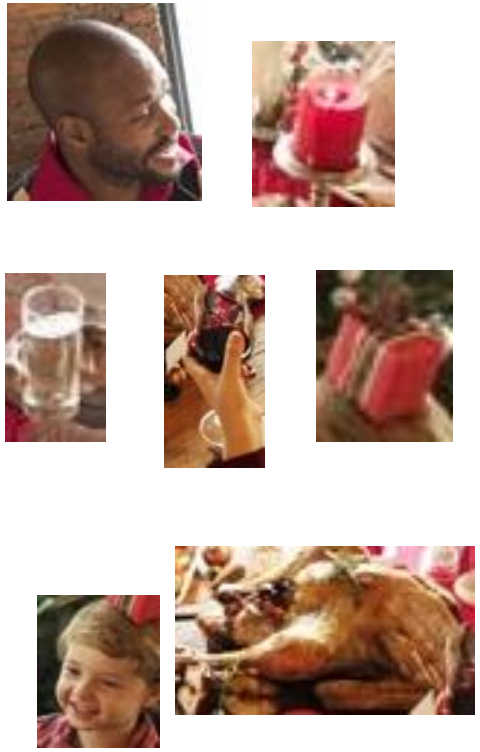
Forms of consciousness associated with declarative memory:

- Semantic memory → noetic consciousness
- Episodic memory → autonoetic consciousness

1. Systems of memory

Episodic memory

Items



+

Context

=

Episode

1. Systems of memory

Episodic memory

« When did I meet Peter? »

« What was the last time I went to this place? »

1. Systems of memory

Episodic memory

2. Mental time travel and construction of identity

Autonoetic awareness: sense of re-experiencing

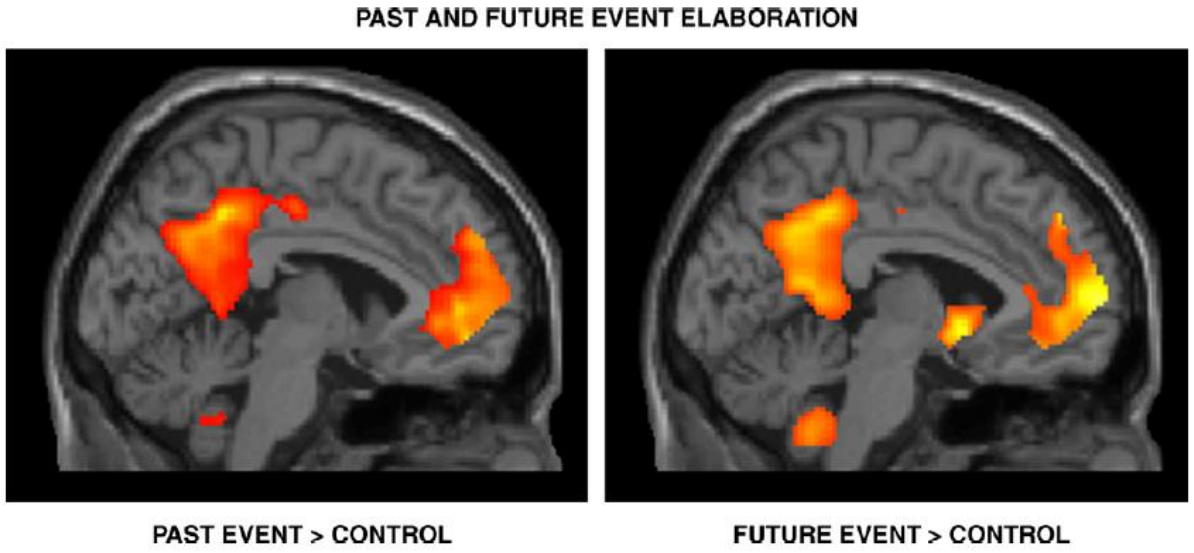
= mental time travel

"We have an autonoetic awareness of one's experiences in the continuity of subjectively apprehended time that extends both backward into the past in the form of **remembering** and forward into the future in the form of **thinking about or imagining the future**" (Tulving, 2001)

2. Mental time travel and construction of identity

Remembering and future thinking

- Both impaired in amnesia
- Overlapping neural bases



Addis et al. (2007, Neuropsychologia)

Tulving:"What will you be doing tomorrow?"
(There is a 15-second pause)
K.C.: smiles faintly, then says, "I don't know"
Tulving:"Do you remember the question?"
K.C.: "About what I'll be doing tomorrow?"
Tulving: "Yes. How would you describe your state of mind when you try to think about it?"
(A 5-second pause)
K.C.: "Blank, I guess"

2. Mental time travel and construction of identity

Remembering and future thinking

Constructive episodic simulation hypothesis (Schacter& Addis, 2007)

Episodic simulation (or future thinking) is based on an episodic memory system that provides

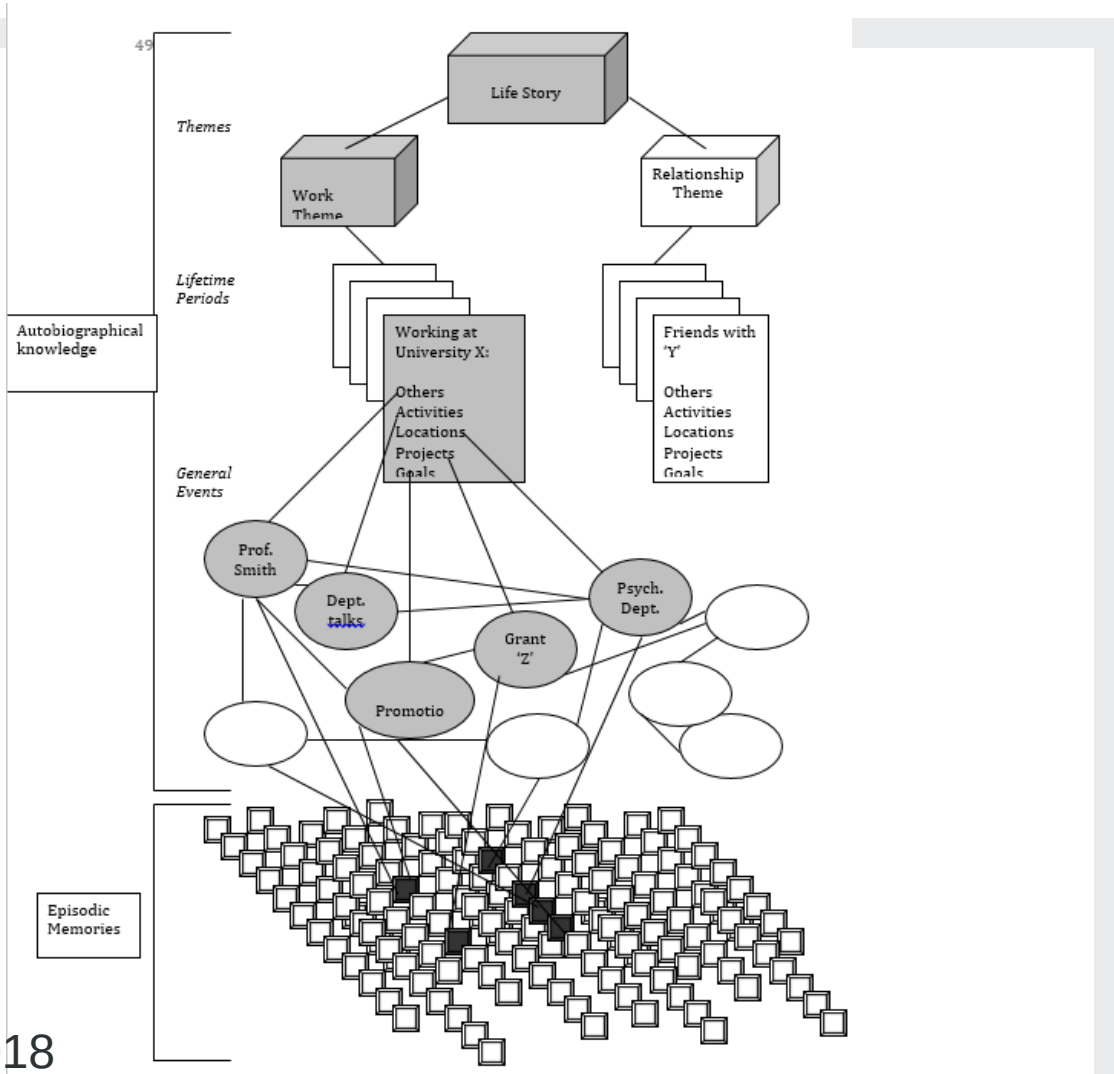
- access to stored episodic details
- the constructive processes to flexibly retrieve and recombine these details for the mental simulation of hypothetical episodes

2. Mental time travel and construction of identity

Memory and the construction of identity

- Episodic memories = details derived from single experiences (‘*experience-near*’)
- EM grouped temporally. AK grouped thematically
- Daily experiences (EM) are destined to be forgotten, unless they support long-term goals
- AK organization driven by goals and coherence of the Self (conceptual self) → stable self image

- Retrieval of a specific event starts from general knowledge (cue specification).

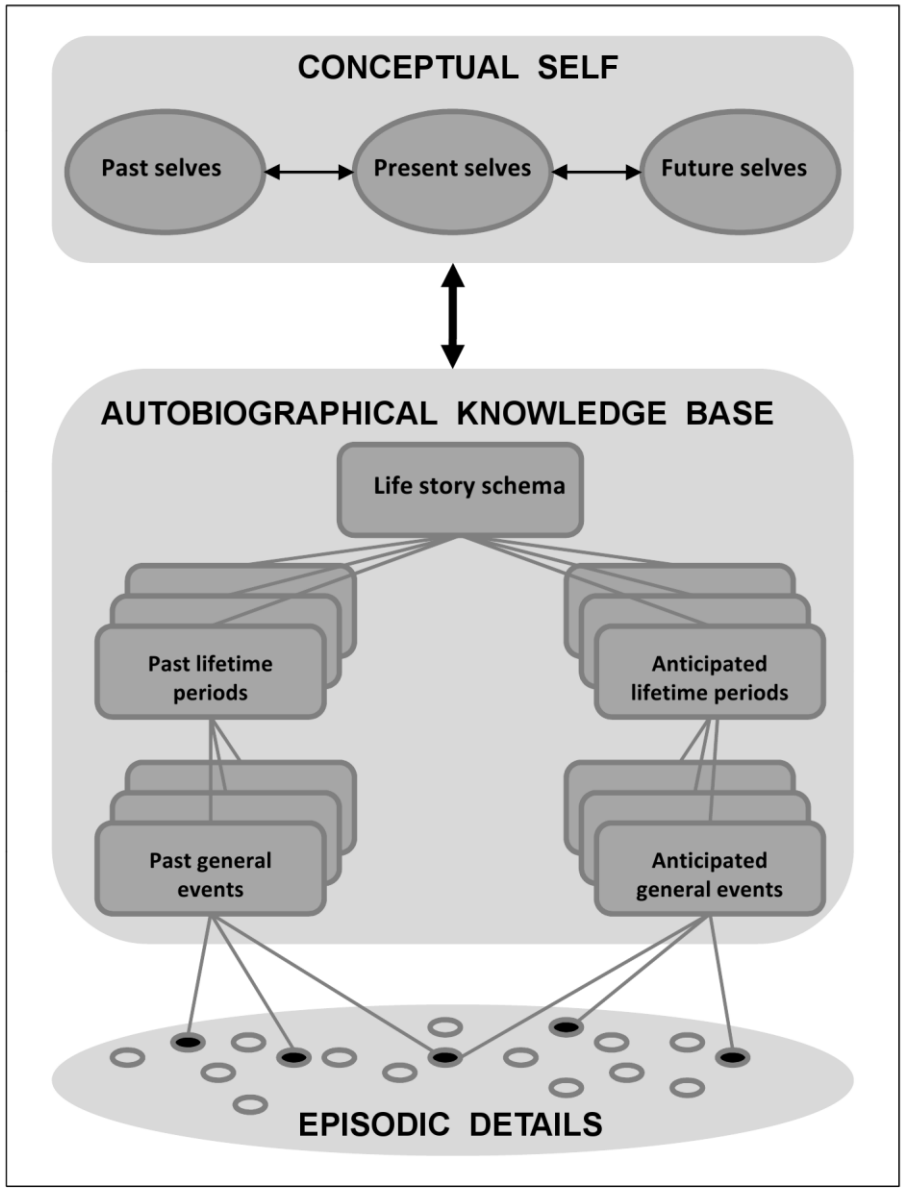


Conway et al., 2018

2. Mental time travel and construction of identity

Memory and the construction of identity

- For imagined events to be perceived as possible future happenings, they have to be placed in an autobiographical context.
- Future self: knowledge about personal goals and anticipated self-attributes, in continuity with past and present self.
- Lifestory schema = an overall representation of a person's entire life that covers both the past and the future.
- Anticipated lifetime periods and general events derive from cultural life scripts (i.e., shared knowledge about a series of events that represents a prototypical life course in a given culture) or may be based on personal experiences, interests, and goals.

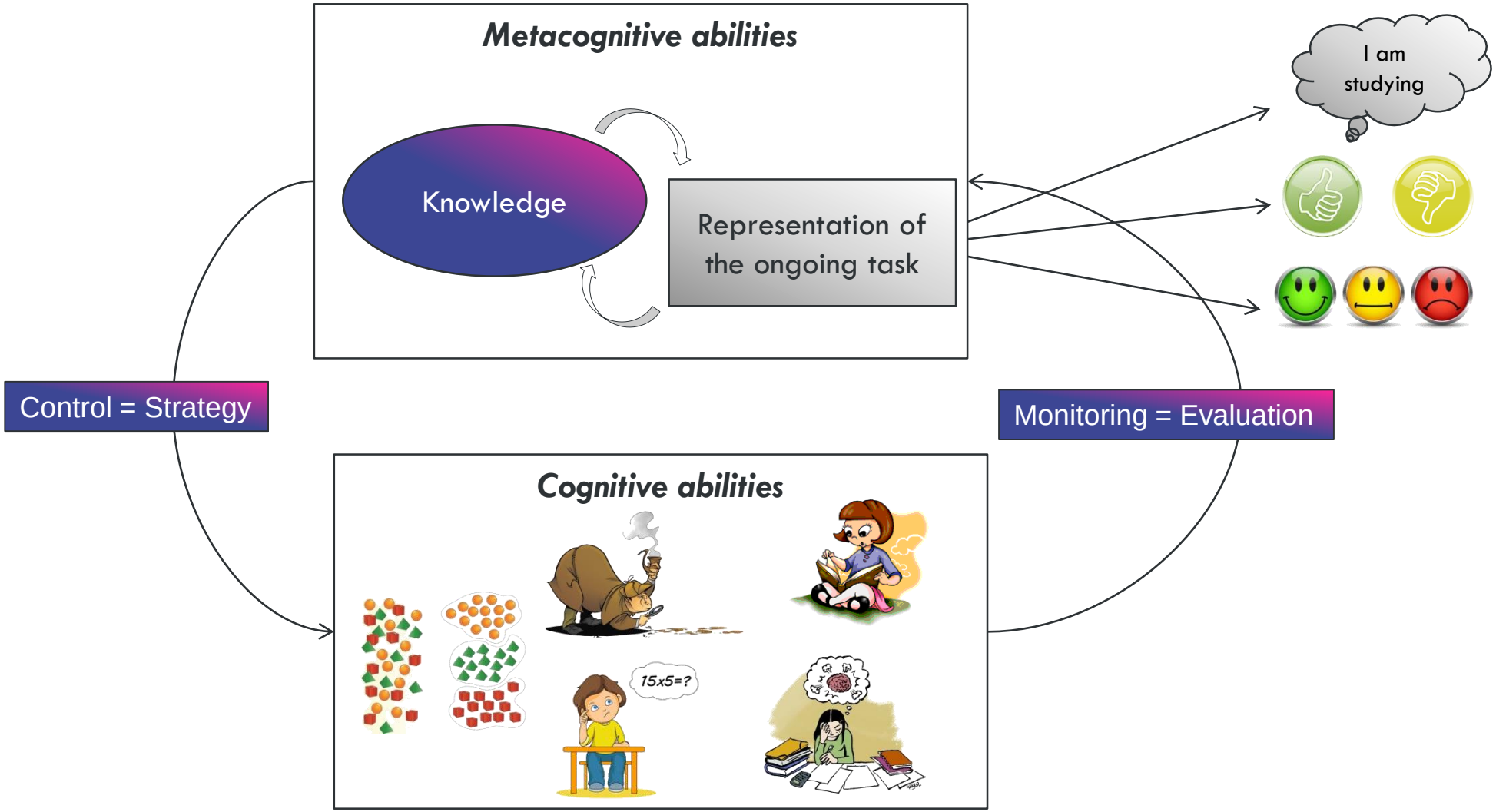


Conway et al., 2018

3. Metacognition

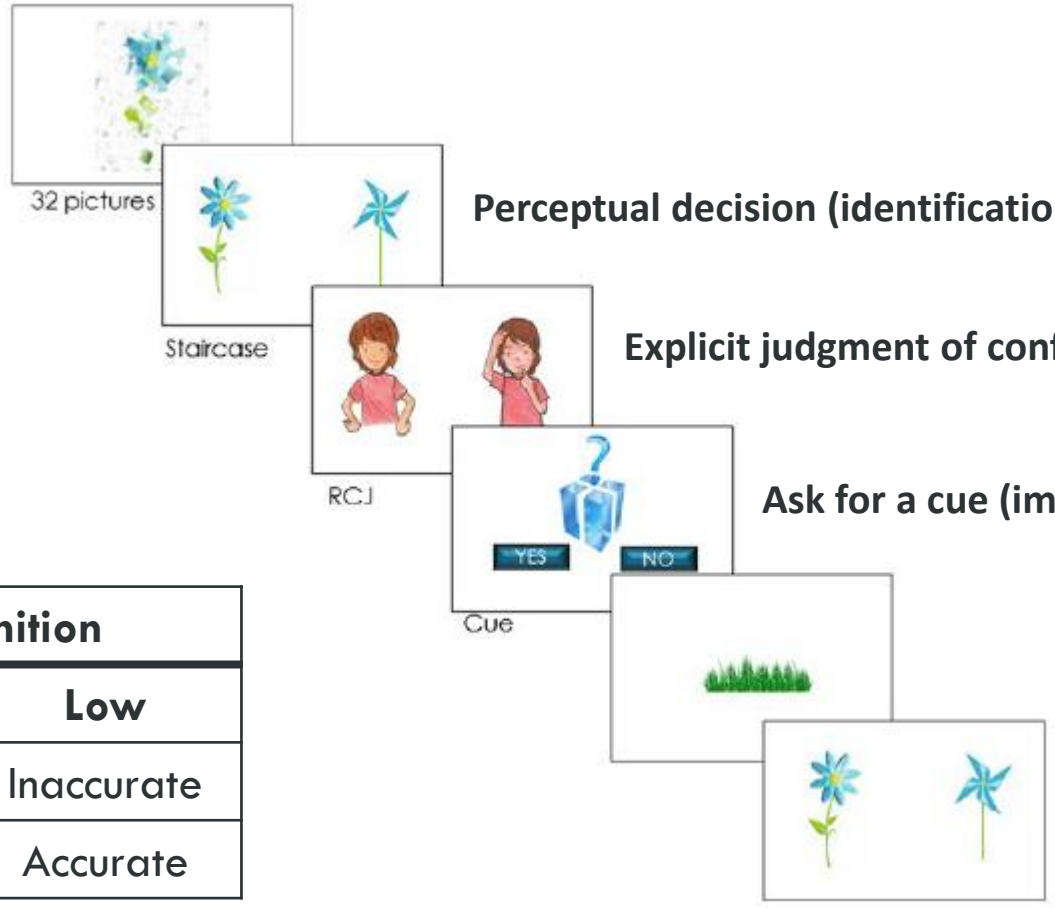
Metacognition = awareness of one's own functioning and cognitive abilities

3. Metacognition



3. Metacognition

Implicit and **explicit** metacognition



Perceptual decision (identification)

Explicit judgment of confidence

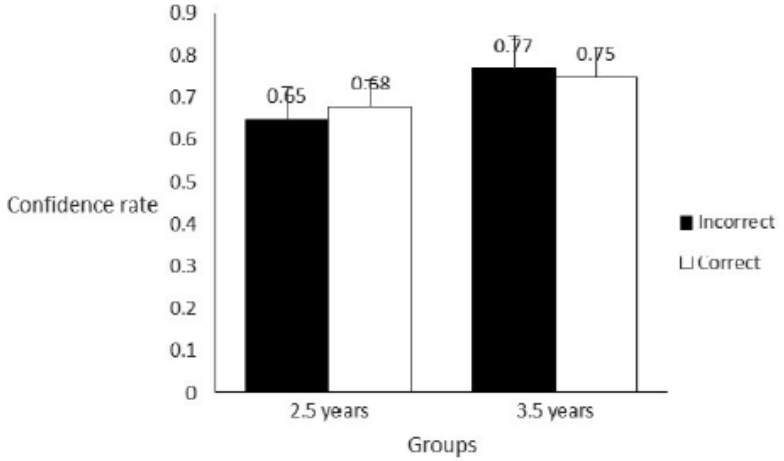
Ask for a cue (implicit awareness of performance)

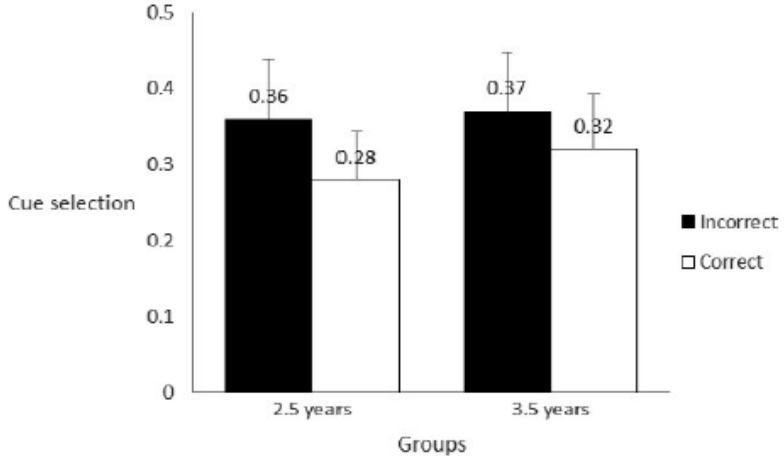
		Metacognition	
		High	**Low**
Identifica-tion	**Correct**	accurate	Inaccurate
	Incorrect	inaccurate	Accurate

3. Metacognition

Implicit and **explicit** metacognition: In young children (2.5 years versus 3.5 years)

Inefficient explicit metacognition at young age;
but efficient implicit metacognition as early as 2.5 years old





Geurten & Bastin (2018, Developmental Science)

3. Metacognition

Implicit and **explicit** metacognition: In Alzheimer's disease

Impaired explicit metacognition, but preserved implicit metacognition

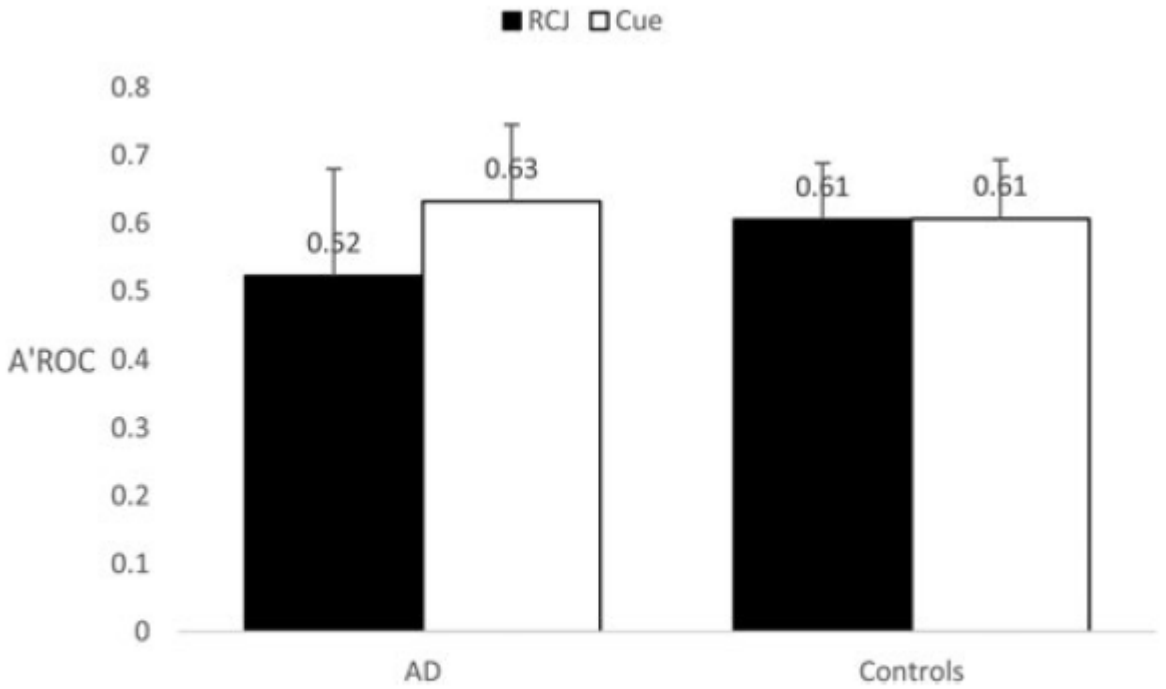


Figure 2. Metacognitive accuracy for the implicit (cue) and explicit (RCJ) measure of metacognitive monitoring in both AD patients and their matched controls; RCJ = retrospective confidence judgment.

Geurten, Salmon & Bastin (2019, Aging and Mental Health)

3. Metacognition

Anosognosia in Alzheimer's disease

= lack of awareness about the disease, the cognitive deficits, and their functional consequences

Anosognosia cause many problems in everyday life:

- Reduced compliance to treatment and therapeutic interventions
- Less efficient cognitive rehabilitation
- Poor interpersonal relationships
- Increased burden for the caregivers

3. Metacognition

Anosognosia in Alzheimer's disease

What are the mechanisms that explain anosognosia?

→ Cognitive neuroscience approach

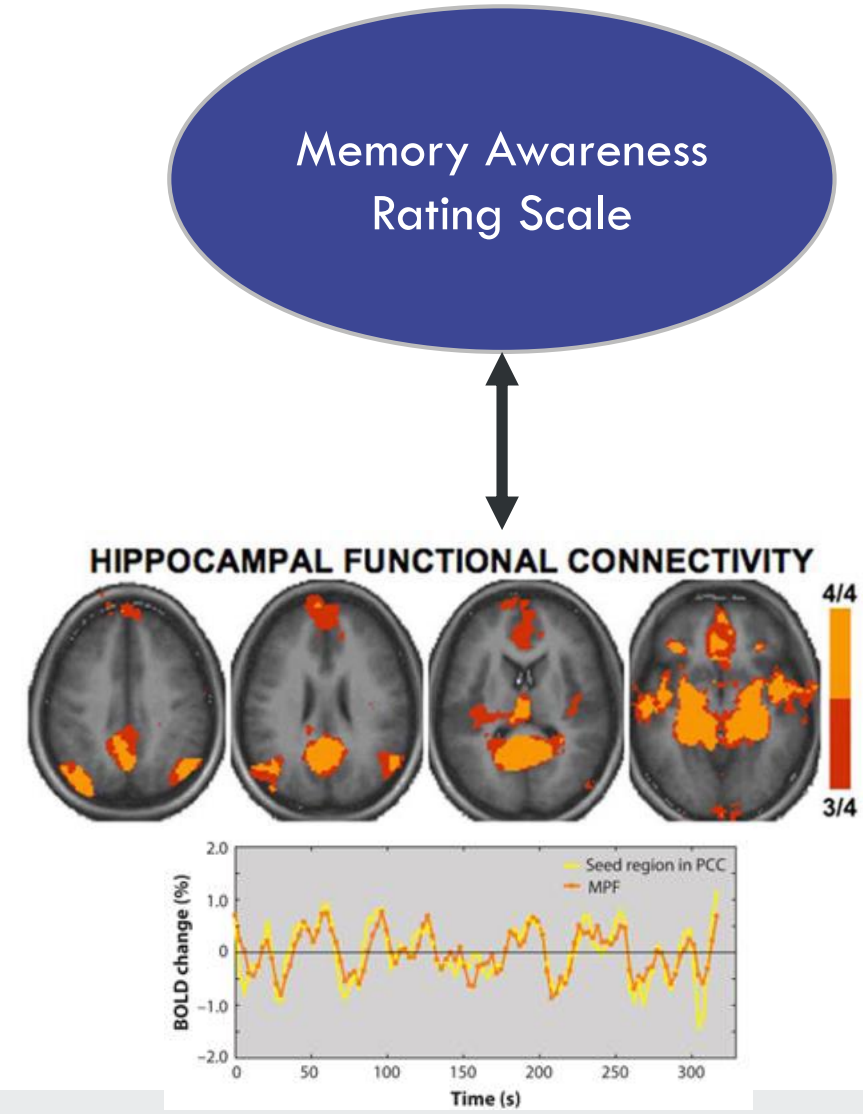
3. Metacognition

Anosognosia in Alzheimer's disease

Relationship between degree of anosognosia

and

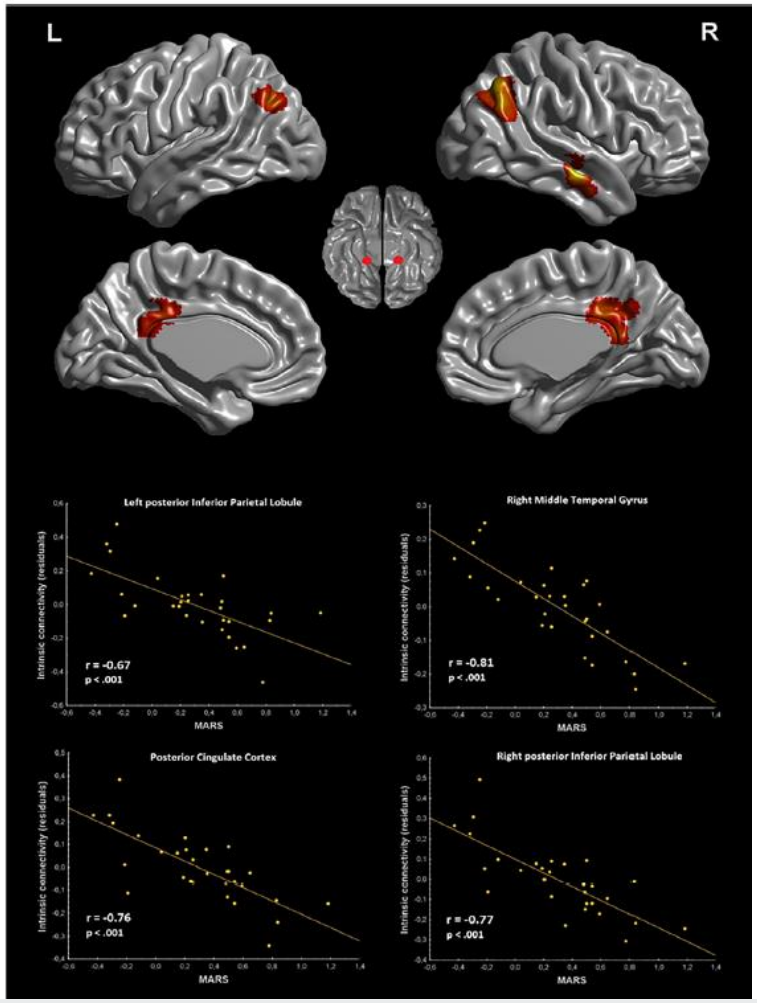
functional connectivity at rest (fMRI)



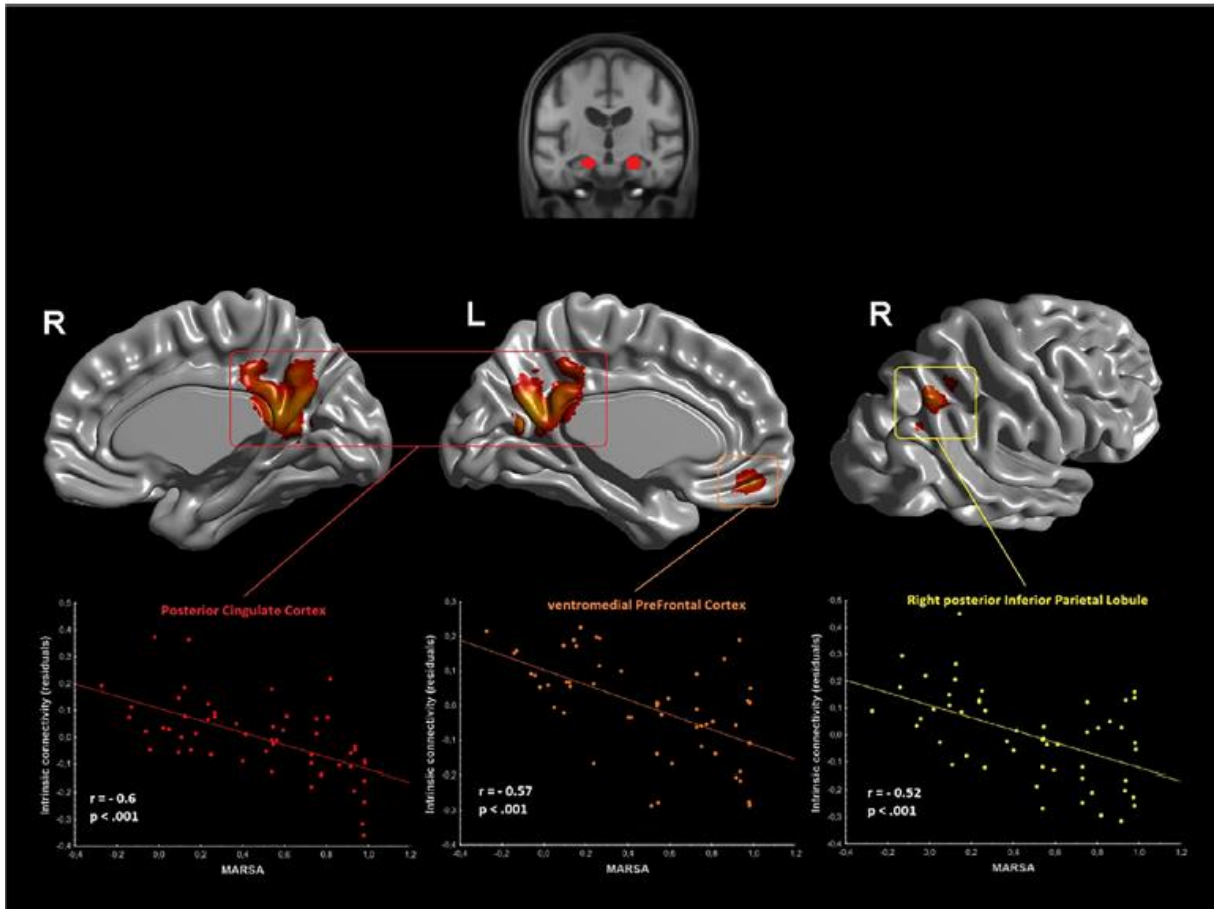
Antoine et al. (2019, Human Brain Mapping)

3. Metacognition

Exp. 1



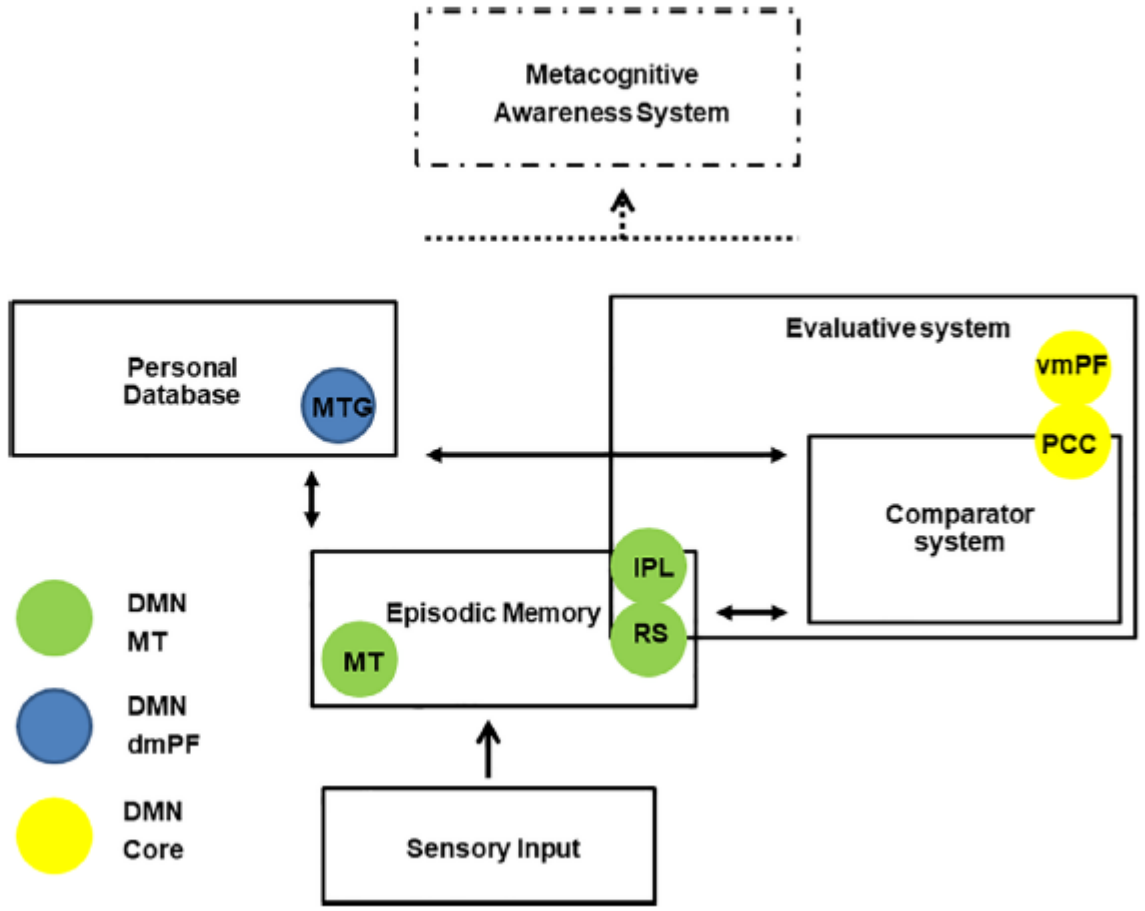
Exp. 2



3. Metacognition

Anosognosia in Alzheimer's disease

FIGURE 3 A simplified representation of the cognitive awareness model. Brain regions in the DMN showing disconnection with our medial temporal seed regions are superimposed on the model. dmPF, dorsomedial prefrontal; IPL, inferior parietal cortex; MT, medial temporal; MTG, middle temporal gyrus; PCC, posterior cingulate cortex; RS, retrosplenial cortex; vmPF, ventromedial prefrontal cortex



Antoine et al. (2019, Human Brain Mapping)

Conclusion

Memory supports consciousness

- Of our past
- Of our future
- Of our identity
- Of our own abilities (strengths and weaknesses)

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Christine.Bastin@uliege.be