

Memory impairments in dementia: Which memory and how does it fail?

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Episodic memory, working memory, semantic memory, procedural memory are all impaired at some stages of dementia. Most complaints however concern recent episodic memories.

From a cognitive viewpoint, there are several theories that distinguish two functions for retrieval of recent information. Recollection corresponds to the retrieval of information associated to the context of information encountering (time, place, circumstances, and possibly emotion and personal thoughts). Familiarity corresponds to the mere feeling of knowing the information without access to the context of encoding. Recollection is certainly impaired at early stages of dementia, while the status of familiarity, mostly studied in Alzheimer's disease (AD), is more debated.

From a cerebral viewpoint, adequate realization of daily activities seems to depend on a flexible shifting between brain activity oriented either to external stimuli or to personal (internal) stimuli. Episodic memory and orientation to self (personal information) depend on the adequate functioning of a relatively common network of brain regions comprising medial temporal structure (such as the hippocampus), posterior cingulate cortex (PCC), medial prefrontal cortex and inferior parietal regions. The regions in this network are the most active cerebral regions during quiet wakefulness, and the network is also called 'default mode' network. Attention to the environment depends on the activity of a network comprising superior parietal and posterior lateral frontal cortices.

Recent data on episodic memory demonstrate that short delay acquisition of verbal information from trial to trial (a delay of few minutes) is already impaired in AD patients, and performance (the amount of information gained over trials) is related to residual hippocampal metabolic activity (Genon et al., 2012). Short delay

consolidation impairment (reflected by progressive loss of previously acquired verbal information from trial to trial) is also observed in patients with mild AD (Genon et al., 2012).

Some patients with another dementia, frontotemporal dementia (FTD), have impaired retrieval of episodic memories. Those patients, who do not retrieve personal information on the context of encoding of the verbal information have a decreased metabolism in the anterior medial prefrontal cortex and the PCC. The metabolic data suggest that impaired conscious retrieval of episodic memories in FTD patients may partly stem from deficient access to and maintenance/use of information about the self (Bastin et al., 2012).

Controlled episodic retrieval and familiarity were recently studied in early stages of AD (Genon et al, 2012). Participants were first asked to form associations between word pairs. They were subsequently presented with word pairs and they had to recognize the associations made at encoding while rejecting “recombined” pairs made of non-associated but previously encountered words. Accurate controlled retrieval was related to PCC activation in both AD patients and older controls. However, in AD patients compared to controls, the PCC was functionally disconnected from the hippocampus and inferior parietal cortex, which is probably related to a decrease of contextual details that AD patients can report.

In this experiment, familiarity for recently encountered information was preserved, and it was related to intraparietal activation in both controls and patients. A series of behavioural studies explored different processes involved in familiarity. Memory in AD patients is influenced by priming. Accordingly, their behaviour (reaction) concerning information they do not consciously recollect is influenced (to the best or to the worse) by a prior encounter of the information, possibly leading to false recognition. However, it has been demonstrated that AD patients in early stage are able to take the circumstances of the retrieval situation into account to trust (or not) their “feeling of familiarity” (Willems et al., 2009). Visual recognition is also shown to be influenced by processing strategies. An analytic strategy, for which AD patients concentrate on details because the information appears difficult to memorize, does reduce both priming memory and conscious recognition (via familiarity). On the contrary, a holistic strategy that allows considering the visual information as a whole does improve (unconscious) priming and conscious recognition (Willems et al., 2008).

In summary, controlled episodic retrieval of information is impaired in cortical dementia, such as AD and FTD, probably because brain regions of a core episodic network are disconnected. Familiarity is a complex function depending on several processes. Several of those processes appear to be relatively preserved in AD and

FTD. It remains to understand which disconnections are responsible for which loss of controlled information, which possible compensatory mechanisms are available for attenuating memory disorders in AD, and how several familiarity processes can be efficiently used to allow AD patients performing valuable daily activities.

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Conflict of Interest

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References

- Bastin C, Feyers D, Souchay C, Guillaume B, Pepin JL, Lemaire C, et al. Frontal and posterior cingulate metabolic impairment in the behavioral variant of frontotemporal dementia with impaired auto-noetic consciousness. *Hum Brain Mapp* 2012; 33: 1268-78.
- Genon S, Collette F, Moulin CJ, Lekeu F, Bahri MA, Salmon E, et al. Verbal learning in Alzheimer's disease and mild cognitive impairment: fine-grained acquisition and short-delay consolidation performance and neural correlates. *Neurobiol Aging* 2012.
- Willems S, Germain S, Salmon E, Van der Linden M. Patients with Alzheimer's disease use metamemory to attenuate the Jacoby-Whitehouse illusion. *Neuropsychologia* 2009; 47: 2672-2676.
- Willems S, Salmon E, Van der Linden M. Implicit/explicit memory dissociation in Alzheimer's disease: The consequence of inappropriate processing? *Neuropsychology* 2008; 22: 710-717.

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