Age-related impairment in memory recall depends on what you are remembering

Jennifer Gove [a], D. Merika Sanders [b], Zhuohan Jiang [c], David Huber [a], Rosemary Cowell [a,*]

[a] *University of Colorado Boulder, USA*
[b] *Harvard University, USA*
[c] *McGill University, Canada*
* Corresponding author.

Amnesic patients show impairments on explicit recall and recognition, but preserved measures of implicit memory such as word-stem completion. This is interpreted as impaired "elaborative processing" or effortful retrieval, with preserved "activation" or priming (Graf et al., 1984). However, this interpretation is incompatible with representational accounts of memory, which suggest that circumscribed cognitive processes (e.g., recollection) provide inadequate labels (i.e., inappropriate "currency") for the deficits caused by brain damage. Instead, representational accounts claim that brain damage impairs not "recall ability" per se, but the ability to solve any cognitive task that relies on representations normally residing in the damaged region, e.g., hippocampus (Cowell et al., 2019). Thus, manipulating the to-be-remembered content so that it does not rely on hippocampal representations should reduce the recall deficit. We tested this in older adults, who often suffer incipient loss of hippocampal function. We tested whether age-related recall deficits are modulated not by whether retrieval is explicit or implicit, but by the content of the to-be-retrieved memory. We used a non-associative recall task in which images (of objects and scenes) were studied in isolation, and image patches were used as cues. Both explicit and implicit retrieval were tested. Scenes should rely on hippocampal representations, causing problems for older adults, whereas objects should not. Older adults were impaired relative to younger on explicit retrieval of both objects and scenes; this was expected under representational accounts because explicit retrieval benefits from binding of an item with study context, which requires hippocampal representations. In contrast, with implicit recall, older adults were impaired on scenes and unimpaired on objects – also predicted by representational accounts because scene- but not object-processing relies on hippocampus. Age-related impairments in memory retrieval depend not on the explicit/implicit status of the task, but on the content of the memory (Fig. 1).

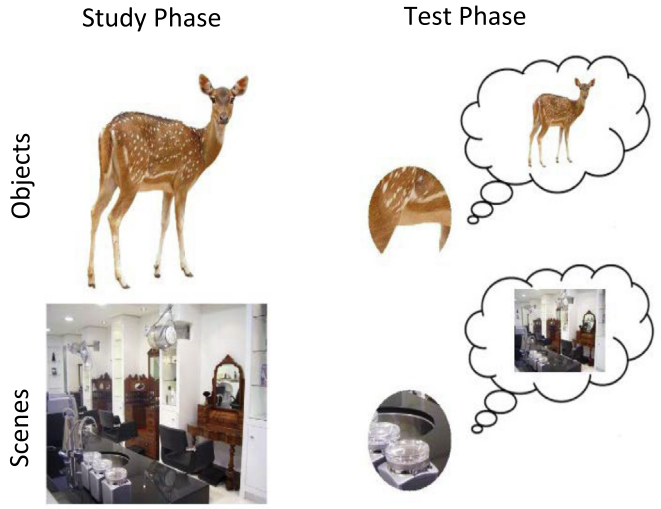

Fig. 1. Stimuli used in the non-associative recall tasks: Objects (top row) and Scenes (bottom row). Participants first studied whole images (left column), then were tested on both explicit and implicit retrieval using circular patches of the images (right column).

References

Graf, Squire, Mandler, 1984. The information that amnesic patients do not forget. Journal of Experimental Psychology: Learning, Memory and Cognition 10 (1), 164–178. https://doi.org/10.1037/0278-7393.10.1.164.

Cowell, Barense, Sadil, 2019. A roadmap for understanding memory: Decomposing cognitive processes into operations and representations ENEURO.0122-19.2019 eNeuro 6 (4). https://doi.org/10.1523/ENEURO.0122-19.2019.

doi: 10.1016/j.bandc.2023.106024

Evidencing representational specialisation of the anterior hippocampus and perirhinal cortex across memory and non-memory operations

Jeremy Gardette [a,*], Jessica Bourgin [a], Olivier Moreaud [a,b], Emilie Cousin [a], Pascal Hot [a,c]

[a] *Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, LPNC, France*
[b] *Centre Mémoire de Ressources et de Recherche, Pôle de Psychiatrie et Neurologie, CHU Grenoble, France*
[c] *Institut universitaire de France, France*
* Corresponding author.

A growing body of research has shown that medial temporal regions play a role outside the memory domain, as they would be specialised in processing certain types of *representations*. In this view, the hippocampus and perirhinal cortex (PRC) would represent scenes and entities, respectively, independently of the memory or non-memory operation performed on it (Cowell et al., 2019). Using fMRI, we tested this prediction in the operations of pattern-completion (i.e., the operation involved in recollection), familiarity-based recognition and rejection, and visual discrimination of scene and object images. Fifty-one participants first completed a visual-discrimination task with objects and scenes. Subsequently, a first group of 25 participants were presented with partial visual cues, and were instructed to reconstruct the original images from memory, thus measuring pattern-completion. A second group (n = 25) underwent a traditional remember/know paradigm, intended to measure familiarity-based recognition and rejection of scenes and objects. Hippocampus and PRC regions of interest were drawn on each subject's native scans (Fig. 1A). As predicted, the hippocampus was preferentially recruited by scene processing in the four operations studied (example in pattern-completion in Fig. 1B). Moreover, a conjunction analysis revealed that a same region in the right anterior-medial hippocampus was significantly activated in all task conditions for scene processing compared with object (Fig. 1C and D). In contrast, the PRC was more engaged for object than for scene processing in all operations except strength-signal rejection. By showing that the hippocampus and PRC respond to representations *independently* of the operation, these results support the representational view of the MTL: the engagement of these regions in processes such as recollection and familiarity would be determined by the representation involved rather than by the operation. Finally, these results highlight the complex functional organisation of the long and transverse axes of the hippocampus.

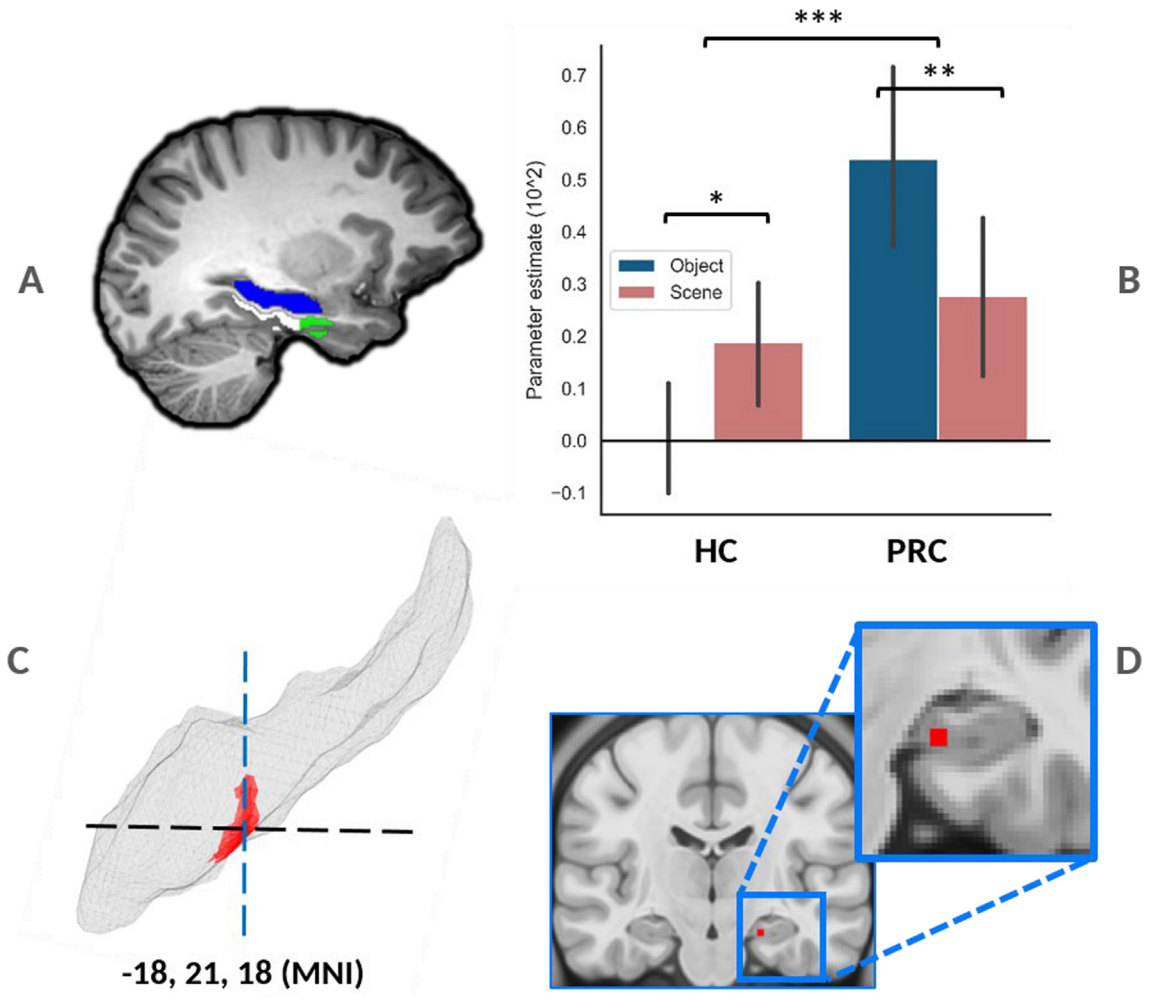

Fig. 1. A. Hippocampus (blue) and PRC (green; the posterior parahippocampal gyrus is in white) regions of interest drawn on a representative subject's anatomical scan. B. Parameter estimates extracted from pattern-completion trials in the HC and PRC for scenes and objects. C. Location of the anterior medial HC cluster revealed by the conjunction analysis between the four task conditions projected on a 3D render. D. Coronal slice showing the position of this cluster in the HC on the icbm T1 template. HC: Hippocampus, PRC: Perirhinal cortex, *: $p < .05$, **: $p < .01$, ***: $p < .001$.

References

Cowell, R.A., Barense, M.D., Sadil, P.S., 2019. A roadmap for understanding memory: Decomposing cognitive processes into operations and representations. eNeuro 6 (4). https://doi.org/10.1523/ENEURO.0122-19.2019.

doi: 10.1016/j.bandc.2023.106025

Manipulating depth of encoding and condition of priming; the influence of semantic variation on the Jacoby and Whitehouse Illusion

Sandra Invernizzi [a,*,1], Manon Demonty [b,1], Laurent Lefebvre [a], Christine Bastin [b], Isabelle Simoes Loureiro [a,1], Emma Delhaye [b,1]

[a] *Cognitive Psychology and Neuropsychology Department, University of Mons, Belgium*

[b] *GIGA-Cyclotron Research Center-in vivo imaging, University of Liege, Belgium*

* Corresponding author.

Jacoby and Whitehouse (JW) (1989) showed that feeling of oldness for words can be manipulated by presenting a prime (Rajaram & Geraci, 2000; Taylor & Henson, 2012) (repetition, e.g. cat – CAT, or semantic; e.g. cat - DOG) less than 50 ms before the word to be recognised, eliciting more correct (hits) or incorrect (false alarms) recognitions. These 'old' responses can rely on familiarity (sense of knowing) or recollection (recollecting a complete context), both processes being differentially enhanced by the nature of the prime (repetition or semantic). While some authors showed that semantic priming increases familiarity-based recognition for both hits and false alarms, others showed a link between semantic priming and recollection, specifically for hits. As semantic links between prime and probe can be either taxonomic (dog-cat) or thematic (dog-leash) and that both systems are distinct, we conducted two experiments (Exp1, N = 61, age = 24.1 ± 4.37; Exp 2, N = 61, age = 23.5 ± 2.45) using JW protocols, in which priming conditions were strictly balanced between repetition/taxonomic/thematic. In Exp 2 we also manipulated encoding depth across three levels (shallow, taxonomic, thematic). Results of Exp 1 showed that, with a classical encoding phase (read and remember), all 3 priming conditions significantly increased familiarity-based false alarms ($F_{(1)} = 15.54$, $p < .001$, $\eta_p^2 = .21$), but not hits. Results of Exp 2 showed that semantic encoding conditions (taxonomic/thematic) significantly increased hits ($F_{(2)} = 134.32$, $p < .0001$, $\eta_p^2 = .43$) especially those based on familiarity ($F_{(2)} = 166.15$, $p < .0001$, $\eta_p^2 = .47$), and that the participants had even more familiarity-based hits when the encoding phase encouraged deep thematic or taxonomic processing and that the priming was of repetition type (*Tukey adj.* $p = 0.03$). Our

[1] These authors contributed equally to this article.