Prior knowledge effect on post-encoding brain connectivity and its relation to subsequent memory
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Introduction
Post-learning brain activity has been shown to reflect offline memory processing, possibly related to memory consolidation processes (Wilson & McNaughton, 1994; Oudette & Paller, 2013; Tampini & D'Avanzo, 2011; Sperling et al., 2010). Recent studies also found that prior knowledge may modulate brain activity during memory processing and facilitate memory consolidation (e.g., Tse et al., 2007; van Kesteren et al., 2010a; 2006b). However, how prior knowledge can affect post-encoding brain activity has not been investigated thoroughly.

In this fMRI study, we asked participants to associate novel houses with famous or nonfamous faces and investigated how associative encoding tasks with or without prior knowledge (i.e., famous vs. nonfamous condition) differentially affected post-encoding brain connectivity measured during rest periods.

Regions of interest (ROIs): We focused on the connectivity between the hippocampus (HPC), anterior temporal pole (aTPL), ventral medial prefrontal cortex (vmPFC), fusiform face area (FFA), and parahippocampal place area (PPA). All were involved in the associative encoding processing.

We hypothesized that (1) the vmPFC and aTPL should form stronger connectivity with the HPC, PPA, and FFA, and that (2) the HPC should form stronger connectivity with the PPA and FFA, during the post-famous-encoding rest compared to the post-nonfamous-encoding rest, reflecting stronger cortical involvement from anterior brain regions and stronger HPC binding during early memory consolidation when prior knowledge was involved. (3) These connectivity measures should also better predict the associative memory performance in the famous than the nonfamous condition.

Method
Participants:
- Twenty university students from the University of Toronto participated in this study (12 females, age mean = 21.3 years, SD = 1.90 years).

Stimuli and procedure:
- 60 house - famous face pairs and 60 house - nonfamous face pairs;
- 36 scrambled picture pairs;
- During encoding, participants were asked to imagine and memorize the face and house pictures together, then indicate whether it was easy or difficult to do so;
- During rest, participants were asked to relax and remain awake.

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References:


Stimuli and procedure: encoding and resting scans

Functional ROI definition:
- vmPFC, aTPL, & HPC: Using encoding task analysis (face-house pairs > scrambled pairs). FFA/PPA: using face/house localizer task.

Analyses:
- SPM (University College London, UK; www.fil.ion.ucl.ac.uk/spm) and conn toolbox (Whitfield-Gabriels and Nieto-Castanon, 2012) were used: Filter .008-1 Hz; CompCor (white matter, CSF, movement).
- Functional connectivity between ROIs was measured using Pearson correlations (Fisher's Z transformed) between ROI mean time series (using conn toolbox).
- Statistical threshold: false detection rate (FDR) of .05 was used to correct multiple testing for each ROI based analysis.

Behavioral results:
- Associative memory accuracy was significantly higher for the famous than the nonfamous condition, t = 4.60, p < .0002.

Effects of associative encoding on post-encoding brain connectivity - ROI analysis:
- Results: R-HPC connectivity with L-FFA was stronger during the post-famous than post-nonfamous rest.
- R-HPC connectivity with L-FFA during post-encoding, but not pre-encoding, rest differentially predicted subsequent associative memory in the two fame conditions.

Conclusion
The post-encoding MTL connectivity was stronger following encoding of associations with famous than non-famous faces.

Functional connectivity between the left HPC and the right FFA, between the left anterior temporal pole region (aTPL) with the parahippocampal place area (PPA) and left FFA, and between the right aTPL and the left PPA predicted better associative face-house memory, but not item memory, only in the famous condition.

These results indicate that when prior knowledge is involved, the HPC and aTPL, which support prior episodic and semantic memories, respectively, continue to interact with the posterior perceptual brain regions (e.g., the PPA and FFA) during the post-encoding rest to facilitate offline processing of the newly formed memory.