Scientists show how the hippocampus is activated to prioritize our activities

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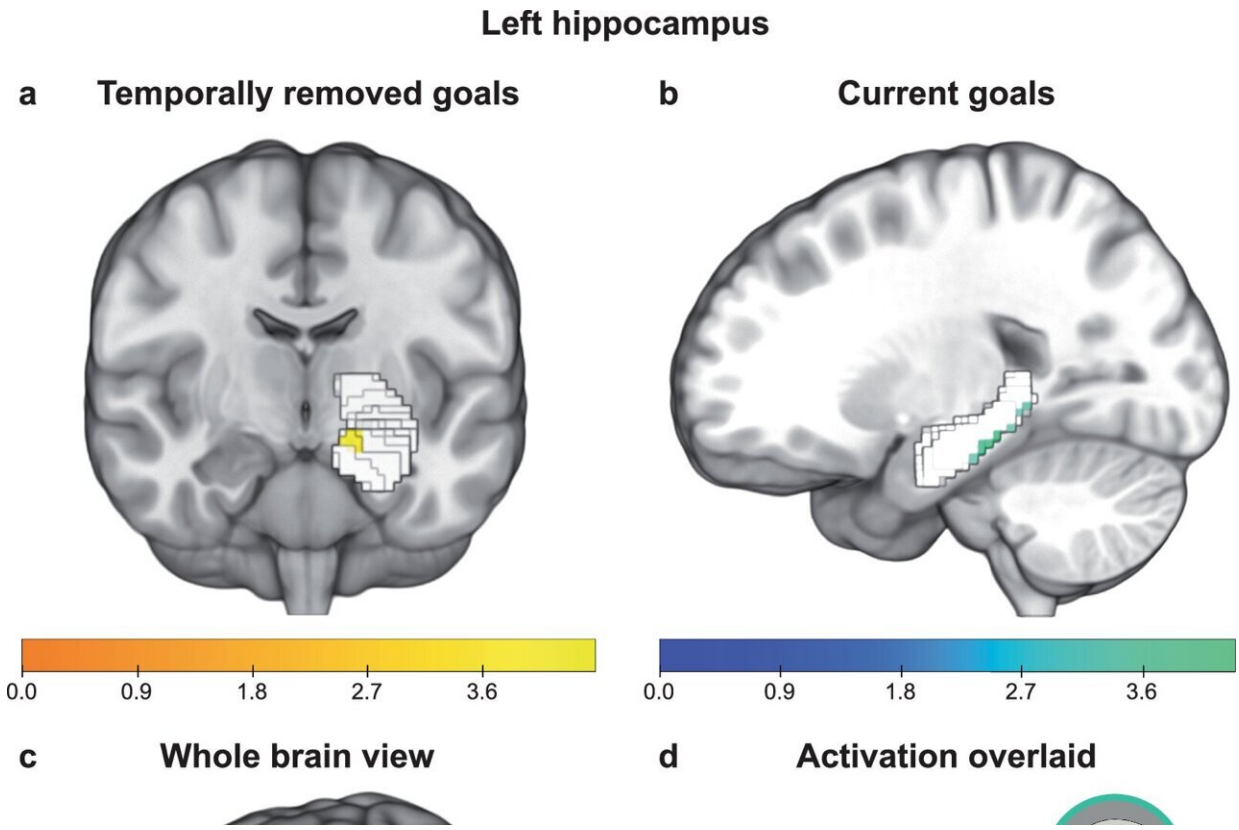

Temporally removed goals activated the left anterior hippocampus and current goals activated the left posterior hippocampus. a Activation maps for the contrasts comparing the remote (distant future + near future + distant past + near past) > current are overlaid in yellow. b Activation maps for the contrasts comparing the current > remote are overlaid in green. c Activation for the temporally removed goals (yellow) and the current goals (green) shown concurrently on the brain. d The same goal, for instance fixing the space helmet, was anatomically dissociated along the longitudinal axis based on whether it was

currently relevant, or relevant at a point removed in time. The left hippocampal region of interest (ROI) is displayed in white. Credit: *Nature Communications* (2024). DOI: 10.1038/s41467-024-48648-9

How does our brain distinguish between urgent and less urgent goals? Researchers at the University of Geneva (UNIGE) and the Icahn School of Medicine in New York have explored how our brain remembers and adjusts the goals we set for ourselves on a daily basis.

Their study reveals differences in the way we process immediate and distant goals, at both behavioral and cerebral levels. These discoveries, published in the journal *Nature Communications*, could have significant implications for understanding psychiatric disorders, particularly depression, which can hamper the formulation of clear goals.

Throughout the day, we set ourselves goals to achieve: picking up the children from school in an hour, preparing dinner in three hours, making a doctor's appointment in five days or mowing the lawn in a week. These goals, both urgent and less urgent, are constantly redefined according to the events that occur throughout the day.

Researchers from the UNIGE and the Icahn School of Medicine at Mont Sinai Hospital in New York have studied how the brain memorizes and updates the goals to be achieved. More specifically, how the brain sorts out which goals require immediate attention and which do not.

Their study focused on a particular region of the brain, the hippocampus, because of its established role in episodic memory. This is responsible for encoding, consolidating and retrieving personally experienced information, integrating its emotional, spatial and temporal context.

An imaginary mission to Mars, in the time of an MRI scan

Neuroscientists asked 31 people to project themselves into an imaginary 4-year space mission to Mars, requiring them to achieve a series of objectives crucial to their survival (taking care of their space helmet, doing exercise, eating certain foods, etc.). The mission objectives varied according to when they had to be achieved, with different tasks for each of the four years of the journey.

As participants progressed through the mission, they were presented with the same objectives. They were then asked to indicate whether these were past, present or future goals.

As the participants moved forward in time, the relevance of these objectives changed: Objectives initially planned for the future became current needs, while current needs became past objectives.

In this way, participants had to manage several objectives at different distances in time and update their priorities as their mission progressed.

Prioritizing immediate objectives

The team observed the reaction times of each individual to determine whether the task was to be achieved in the present, the past or the future. "Goals to be achieved immediately are recognized more quickly than those to be achieved in the distant future. This different processing of stored information reveals the priority given to needs in the present over those in the distant future.

"It takes extra time to mentally travel back in time to retrieve past and future goals," explains Alison Montagrin, research and teaching fellow in

the Department of Basic Neurosciences at the UNIGE Faculty of Medicine, former post-doctoral fellow at the Icahn School of Medicine, and first author of the study.

The scientists also investigated whether differences were also apparent at the cerebral level. Images obtained using very high-resolution MRI revealed that, when retrieving information about the present, the hippocampus is activated in its posterior region. On the other hand, when recalling past goals or goals to be achieved in the future, the anterior region is activated.

"These results are particularly interesting because previous studies have shown that when we call on our episodic memory or our spatial memory, the anterior region of the hippocampus is involved in retrieving general information, while the posterior part deals with details.

"It will therefore be interesting to explore whether—unlike immediate goals—projection into the future or recall of a past goal do not require specific details, but a general representation is sufficient," concludes the researcher.

This research shows that the time scale plays a crucial role in the way people set personal goals. This could have important implications for understanding psychiatric disorders such as depression. Indeed, people suffering from depression may present difficulties in forming specific goals and envisage more obstacles in reaching their objectives.

Investigating whether these people perceive the distance to their goals differently—which could make them pessimistic about their chances of success—could open up a therapeutic avenue.

More information: Alison Montagrin et al, The hippocampus dissociates present from past and future goals, *Nature Communications*

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