

Remembering the past to imagine the future: the prospective brain



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Week 6 Commentary – Remembering the past to imagine the future: the prospective brain

In 2007, Schacter et al. posited that there is a common core brain network involved both in the remembering of one's personal past and imagining the future. The core brain network suggested to participate in these processes are the medial temporal lobe (thought to be critical in the process of remembering the past), the medial prefrontal cortex, the lateral temporal cortex, and the posterior regions in the medial and lateral parietal cortex. While it is believed this core brain system is involved both in remembering and imagining, previous and current research seems to show that different neural regions are active during the two processes; this can be seen in the form of greater activity when individuals imagine the future rather than remember the past. The process of remembering past events is not done so in a preserved rerun fashion, but rather by preserving the general essence and meaning of the event instead. Imagining future events also involves remembered details of past events, that are then combined to form a novel event.

The idea that remembered details are reactivated during the retrieval and integration into the imagining of future events is backed by the concept of episodic memory, or the ability to recollect past experiences. From their findings, Schacter et al. (2007) formed the Constructive Episodic Simulation Hypothesis which states that imagining the future in some way requires a collective system that can flexibly combine details from past events into future novel scenarios. This hypothesis attempts to understand why memory is the supposed literal replay of past events and instead involves a

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constructive process involving the piecing together of various fragments of information. They suppose that memory serves as an anchor of sorts for information necessary to simulate and create the ideas for future events. Past thoughts and ideas of future events draw from the same information storage bank - episodic memory - and the extraction of past memories recombined with stored information can simulate a novel event.

When patients were directed to freely discuss the past or future, a PET scan was able to show evidence of shared neural activity during descriptions of past and future events in the prefrontal cortex and parts of the medial temporal lobe, specifically the hippocampus and the parahippocampal gyrus. Similarly, participants involved in fMRI studies who were asked to think of past events and image future events showed activity in prefrontal and medial temporal regions, as well as in the posterior midline region. A control of sorts was used where the participants were asked to imagine specific events that involved a familiar individual and the aforementioned regions were not activated in the same way. It is posited that a person therefore has their own specific neural signature that provides support in the construction of their own individual past or future. Yet another study researching participant-generated past or future events, with the addition of an elaboration phase, past-future activity was associated with activity in posterior visual regions and the left hippocampus, which may explain the interaction between visually presented cues and hippocampally mediated pointers to memory traces. When asked to elaborate on specific details, activity was noticed in the prefrontal cortex, medial temporal lobe (including

the hippocampus and parahippocampal gyrus) as had been seen in previous studies.

Various studies use generally the same paradigm when conducting memory-related experiments involving neural imaging; participants are placed in PET or fMRI scanners and then asked to remember a memory or imagine a future event related to a particular cue word. Commonly, the same brain regions activate in both scenarios. Further confirmation of this phenomena comes in the form of amnesic patient studies. Individuals with amnesia characteristically have issues with remembering past events, but if asked the correct questions, also show significant deficits in the imagining of their own future. Amnesic patients when asked to provide ideas for new imaginary experiences, tend to produce ideas greatly reduced in content (especially regarding spatial coherence) and detail when compared with controls. This information can suggest that amnesic patient construction consists of isolated fragments of information rather than connected scenes (Schacter et al., 2007). The same type of correlation regarding decreases in specific, detailed imagining and difficulty recalling past events has also been found with healthy elderly patients, patients with suicidal depression, PTSD, and schizophrenia.

Additional research still needs to be conducted focusing on the key aspects of semantic memory that are involved in the construction of imagined future events. Specifically, research needs to compare and contrast episodic memory and semantic memory. Discovering ways to differentiate real memories from false and distorted memories is also of the utmost concern as these can both negatively and inaccurately shape individuals and nurture

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biases as well as feelings, both negative and positive, of self. A greater insight into how the brain utilizes past experiences and the memories from them to generate various future event simulations is important to prepare us for the adaptive functioning necessary in dealing with various possibilities our future may hold. A firmer understanding of the hippocampal involvement in the encoding and retrieval of memories will also prove useful as future simulation could potentially be taking credit from the role of the hippocampus during the process of encoding.

References

- Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: the prospective brain. *Nature reviews neuroscience* , 8 (9), 657.
- Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: remembering, imagining, and the brain. *Neuron* , 76 (4), 677-94.

Discussion Questions:

1. Why do you think emotional events are so closely linked with memory and the ability to create vivid future events?
 1. Findings suggest that details associated with negative simulations are remembered more poorly over time compared with details associated with positive or neutral simulations
2. What involvement do you think semantic memory plays in imagining the future?

1. Schacter suggests that semantic memory plays an important role in the process of recombination which is critical for constructing simulated scenarios.