MIT Press • Open Encyclopedia of Cognitive Science

Episodic Future Thinking

Donna Rose Addis[1,2] **Daniel L. Schacter**[3]

[1]Rotman Research Institute, Baycrest Academy for Research and Education,
[2]Department of Psychology, University of Toronto,
[3]Department of Psychology and Center for Brain Science, Harvard University

MIT Press

Published on: Jul 23, 2025

DOI: https://doi.org/10.21428/e2759450.112fbf72

Prospection is an umbrella term for the many types of future-oriented cognition humans engage in and is studied across different subdisciplines of cognitive science. Within cognitive psychology and neuroscience, for example, the focus has been on episodic future thinking: the capacity to imagine specific events that the self may experience in future. Findings from neuroimaging and patient studies demonstrate the close link between episodic future thinking and episodic memories of past experiences. Both abilities rely on the same common core brain network, although episodic future thinking engages many of these brain regions to a greater degree than remembering the past. The constructive episodic simulation hypothesis attributes this increased activation to additional cognitive demands when imagining the future, namely recombining details from episodic memories of past experiences into novel scenarios. Understanding the processes that support episodic future thinking has important theoretical and applied implications.

History

Endel Tulving (1985) was one of the first psychologists to study episodic future thinking (EFT). He probed patient K.C. who had lost his memory (amnesia), asking what he might do tomorrow. K.C. was unable to answer, describing his mental state as "blank." This finding supported Tulving's emerging concept of mental time travel—the ability to traverse one's own personal timeline to re-experience moments in the past and pre-experience moments in the future.

Despite this compelling demonstration that EFT is linked to episodic memory, it was not until the early to mid-2000s that research into EFT took off in earnest. Developmental psychologists Cristina Atance and Daniela O'Neill (2001, 2005) coined the term EFT as the future-oriented form of mental time travel and showed that EFT follows a similar developmental trajectory as episodic memory. EFT was found to be significantly impaired in individuals with amnesia following hippocampal damage, and the first neuroimaging studies of EFT identified key brain regions involved in future thinking such as the hippocampus (Addis et al., 2007; Okuda et al., 2003; Szpunar et al., 2007). Cognitive studies also showed considerable similarities in the subjective qualities of past and future events (D'Argembeau & van der Linden, 2004). These developments saw EFT being named one of *Science*'s top 10 breakthroughs of 2007.

Core concepts

Episodic memory is a constructive process, with the elements comprising a memory pieced together upon retrieval. The constructive episodic simulation hypothesis posits that episodic details from past experiences can be reactivated and recombined to form novel future scenarios (Schacter & Addis, 2007). This theory provides an explanation for the overlapping neural correlates of past and future events as well as the presence of EFT deficits in the context of episodic memory loss. A related concept is that of scene construction, or the process of imagining hypothetical scenes composed of objects and spatial relations among them, which contributes to both remembering and imagining (Hassabis et al., 2007). Other theories emphasize that semantic memory for facts and concepts (Irish et al., 2012), as well as

schemas (Addis, 2020) provide an organizing framework or scaffold to recombine details into coherent imagined events.

The common core network that underpins EFT overlaps considerably with the default mode network, including the medial and dorsolateral prefrontal cortex, medial parietal (posterior cingulate and retrosplenial) cortex, lateral parietal cortex (angular gyrus), and the medial temporal lobes (hippocampus and parahippocampal gyrus; see Figure 1; Schacter et al., 2017). A subset of these regions are more strongly engaged by imagination than remembering, including the hippocampus. This additional activity likely reflects the additional cognitive demands of recombining details into plausible scenarios that are not required when remembering the past as it happened.

Questions, controversies, and new developments

Researchers have debated whether EFT is a uniquely human capacity, and the question of whether nonhuman animals possess the capacity for EFT remains controversial (for a useful discussion, see Osvath, 2016). Although like memory, EFT is thought to be a universal capacity in humans, it does vary across cultures. For instance, there is evidence that in East Asian cultures, EFT focuses more on routine events than unique episodic events (Wang, 2019).

Some neuroimaging studies have found that many of the brain regions in the core network contribute to constructing atemporal scenes (Mullally & Maguire, 2014), speaking against the view that the core network supports mental time travel into the past and future. This network is now thought to support the simulation of other imaginative functions such as planning routes (i.e., navigation), hypothetical events including counterfactual thoughts (De Brigard et al., 2013), and simulation of what others are thinking, both in real life and when reading fiction (Tamir et al., 2016) [see Causal Reasoning].

Recent discussions have distinguished between the temporal component of remembering and imagining on the one hand and the episodic retrieval and recombination processes that contribute to both on the other (Mahr & Schacter, 2024). With respect to the hippocampus specifically, the evidence suggests that it supports multiple processes that contribute to EFT, including episodic encoding, retrieval, and recombination processes (Schacter & Addis, 2007) as well as scene construction (Mullally & Maguire, 2014). Experimental techniques have been developed that can identify the episodic retrieval component of imagined future experiences and link it to activity in the hippocampus and other core network structures (Schacter et al., 2017).

Broader connections

In philosophy, the debate about whether memory and imagination are the same or distinct abilities has drawn on findings from cognitive neuroscience. For instance, the neurocognitive overlap between past and future events provides evidence for the position that both episodic memory and EFT are different outputs of a single event simulation process (Michaelian, 2016).

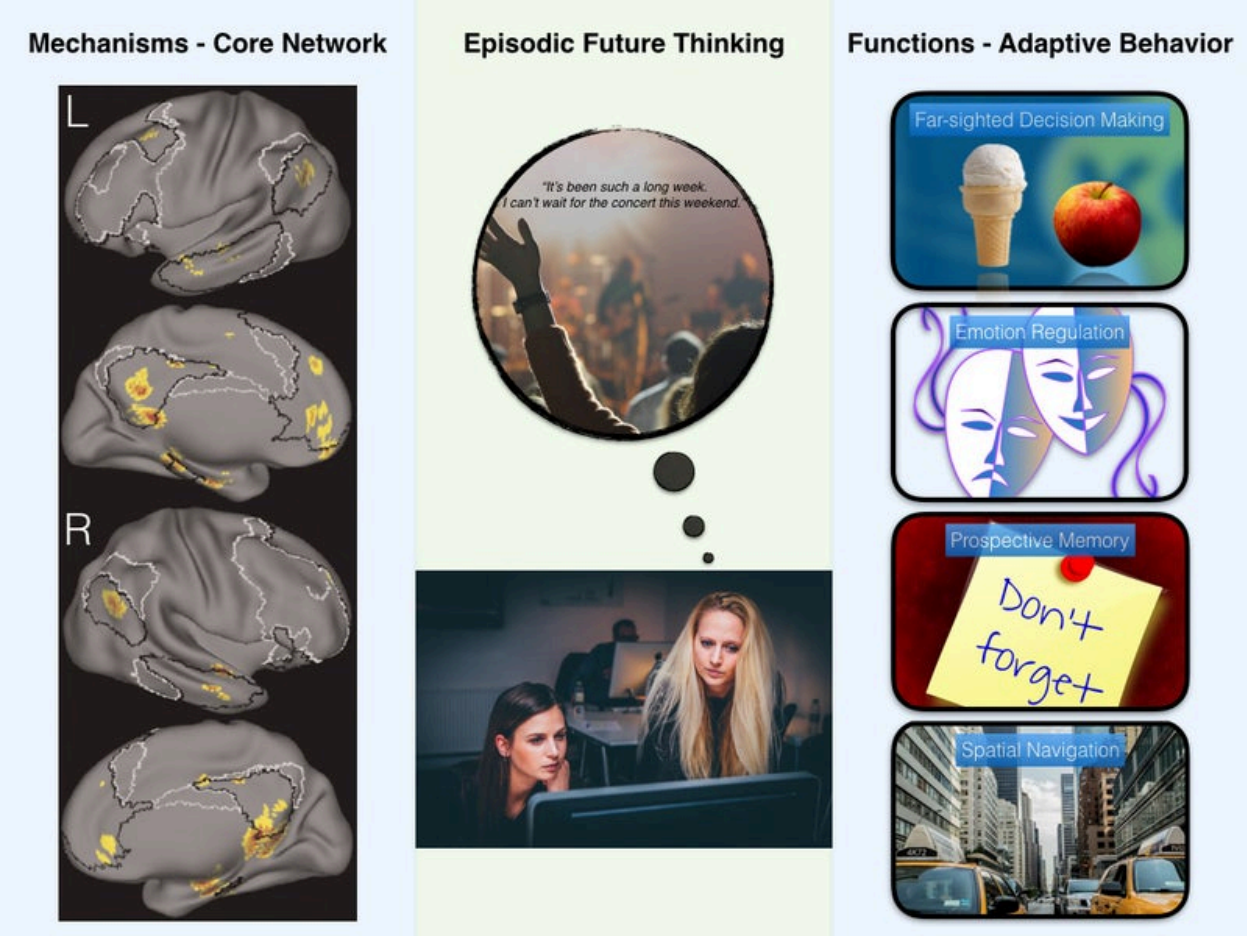

Figure 1
Episodic future thinking is the capacity to imagine specific events that may take place in one's future (middle) and support many adaptive behaviors, including far-sighted decision-making, emotion regulation, prospective memory, and navigation (right panel). In the left panel, the capacity for episodic future thinking is supported by a core brain network that overlaps with the default mode network (black borders) and includes medial and lateral aspects of the frontal, parietal, and temporal lobes. L, left; R, right. Adapted with permission from **Schacter et al. (2017)**.

EFT has many adaptive functions (see Figure 1; Schacter et al., 2017). It helps people to remember what they have planned to do (i.e., prospective memory) and to regulate their emotions, for instance, by reducing worry about the future. In clinical research, disorders of EFT have been documented in various psychopathological conditions, including depression, anxiety disorders, and schizophrenia, and interventions have been developed to reduce the negative consequences of these impairments (Hallford et al., 2020).

Encouraging the use of EFT helps individuals make better decisions; it reduces impulsive decisions and helps people wait longer for larger rewards (*temporal discounting*; Benoit et al., 2011). These findings have led to the development of interventions using EFT that decrease overeating in obese populations, reduce

impulsive drinking in individuals with alcohol dependence, and reduce nicotine consumption in smokers with substance use disorder (for a review, see Brown & Stein, 2022).

Acknowledgments

D.R.A. is supported by the Canada 150 Research Chairs Program and a Discovery Grant (RGPIN-2023-04644) from the Natural Sciences and Engineering Research Council of Canada. D.L.S. is supported by National Institute of Mental Health R01MH60941.

Further reading

- Gamble, B., Moreau, D., Tippett, L. J., & Addis, D. R. (2019). Specificity of future thinking in depression: A meta-analysis. *Perspectives on Psychological Science, 14*(5), 816-834. https://doi.org/10.1177/1745691619851784
- Irish, M., & Piguet, O. (2013). The pivotal role of semantic memory in remembering the past and imagining the future. *Frontiers in Behavioral Neuroscience, 7,* 27. https://doi.org/10.3389/fnbeh.2013.00027
- Mullally, S.L., & Maguire, E.A. (2014). Memory, imagination, and predicting the future: A common brain mechanism? *Neuroscientist, 20*(3), 220-234. https://doi.org/10.1177/1073858413495091
- 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), 677-694. https://doi.org/10.1016/j.neuron.2012.11.001

References

- Addis, D. R. (2020). Mental time travel? A neurocognitive model of event simulation. *Review of Philosophy and Psychology, 11,* 233–259. https://doi.org/10.1007/s13164-020-00470-0 ↩
- Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: Common and distinct neural substrates during event construction and elaboration. *Neuropsychologia, 45*(7), 1363-1377. https://doi.org/10.1016/j.neuropsychologia.2006.10.016 ↩
- Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences, 5*(12), 533-539. https://doi.org/10.1016/S1364-6613(00)01804-0 ↩
- Atance, C. M., & O'Neill, D. K. (2005). The emergence of episodic future thinking in humans. *Learning and Motivation, 36*(2), 126–144. https://doi.org/10.1016/j.lmot.2005.02.003 ↩
- Benoit, R. G., Gilbert, S. J., & Burgress, P. W. (2011). A neural mechanism mediating the impact of episodic prospection on farsighted decisions. *Journal of Neuroscience, 31*(18), 6771-6779.

https://doi.org/10.1523/JNEUROSCI.6559-10.2011

↩

- Brown, J. M., & Stein, J. S. (2022). Putting prospection into practice: Methodological considerations in the use of episodic future thinking to reduce delay discounting and maladaptive health behaviors. *Frontiers in Public Health, 10,* 1020171. https://doi.org/10.3389/fpubh.2022.1020171

↩

- D'Argembeau, A., & van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: Influence of valence and temporal distance. *Consciousness & Cognition, 13*(4), 844-858. https://doi.org/10.1016/j.concog.2004.07.007

↩

- De Brigard, F., Addis, D. R., Ford, J. H., Schacter, D. L., & Giovanello, K. S. (2013). Remembering what could have happened: Neural correlates of episodic counterfactual thinking. *Neuropsychologia, 51*(12), 2401-2414. https://doi.org/10.1016/j.neuropsychologia.2013.01.015

↩

- Hallford, D. J., Takano, K., Raes, F., & Austin, D. W. (2020). Psychometric evaluation of an episodic future thinking variant of the Autobiographical Memory Test—Episodic Future Thinking-Test (EFT-T). *European Journal of Psychological Assessment, 36*(4), 658–669. https://doi.org/10.1027/1015-5759/a000536

↩

- Hassabis, D., Kumaran, D., Vann, S. D., & Maguire, E. A. (2007). Patients with hippocampal amnesia cannot imagine new experiences. *Proceedings of the National Academy of Sciences USA, 104*(5), 1726-1731. https://doi.org/10.1073/pnas.0610561104

↩

- Irish, M., Addis, D. R., Hodges, J. R., & Piguet, O. (2012). Considering the role of semantic memory in episodic future thinking: evidence from semantic dementia. *Brain, 135*(7), 2178-2191. https://doi.org/10.1093/brain/aws119

↩

- Mahr, J. B., & Schacter, D. L. (2024). Episodic recombination and the role of time in mental travel. *Philosophical Transactions of the Royal Society B, 379*(1913), 20230409. https://doi.org/10.1098/rstb.2023.0409

↩

- Michaelian, K. (2016). Against discontinuism: Mental time travel and our knowledge of past and future events. In K. Michaelian, S. B. Klein, & K. K. Szpunar (Eds.), *Seeing the future: Theoretical perspectives on future-oriented mental time travel* (pp. 62–92). Oxford University Press.

  ↩
- Mullally, S.L., & Maguire, E.A. (2014). Memory, imagination, and predicting the future: A common brain mechanism? *Neuroscientist, 20*(3), 220-234. https://doi.org/10.1177/1073858413495091

  ↩
- Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., Kawashima, R., Fukuda, H., Itoh, M., & Yamadori, A. (2003). Thinking of the future and the past: The roles of the frontal pole and the medial temporal lobes. *Neuroimage, 19*(4), 1369-1380. https://doi.org/10.1016/s1053-8119(03)00179-4

  ↩
- Osvath, M. (2016). Putting flexible animal prospection into context: Escaping the theoretical box. *WIREs Cognitive Science, 7*(1), 5-18. https://doi.org/10.1002/wcs.1372

  ↩
- Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal Society B, 362*(1481), 773-786. https://doi.org/10.1098/rstb.2007.2087

  ↩
- Schacter, D. L., Benoit, R. G., & Szpunar, K. K. (2017). Episodic future thinking: Mechanisms and functions. *Current Opinion in Behavioral Sciences, 17,* 41-50. https://doi.org/10.1016/j.cobeha.2017.06.002

  ↩
- Szpunar, K. K., Watson, J. M., & McDermott, K. B. (2007). Neural substrates of envisioning the future. *Proceedings of the National Academy of Sciences USA, 104*(2), 642-647. https://doi.org/10.1073/pnas.0610082104

  ↩
- Tamir, D. I., Bricker, A. B., Dodell-Feder, D., & Mitchell, J. P. (2016). Reading fiction and reading minds: The role of simulation in the default network. *Social Cognitive Affective Neuroscience, 11*(2), 215-224. https://doi.org/10.1093/scan/nsv114

  ↩
- Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist, 25*(1), 1-12. https://doi.org/10.1037/h0080017

  ↩

- Wang, Q. (2019). Culture in the organization of autobiographical memory. In J. H. Mace (Ed.), *The organization and structure of autobiographical memory* (pp. 72-92). Oxford University Press.

  ↩