

1. This is a commentary on the target article by **Johannes Mahr** and **Gergely Csibra**.

**2. Title:**

Episodic Memory Solves Many Problems, Both Social and Nonsocial, and Likely Evolved to Fulfill a Diverse Range of Functions.

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**9. Abstract:**

The episodic memory system is flexible and complex, and likely evolved in response to a wide range of survival-relevant problems in our evolutionary past, both social and nonsocial. Episodic memory allows us to recollect and infer details that may have seemed trivial on encoding, but are now known to be relevant. This aids humans navigate their uncertain environment.

## 10. Main Text:

The target article argues that episodic memory plays an important role in social relations. We wholeheartedly agree, having discussed this association in past work, as have others. The unique contribution of the target article is its proposal that episodic memory evolved to support compelling testimony in the service of social persuasion. This strikes us as an unsuitably narrow characterization of episodic memory. The initial premise that led to this characterization, that episodic memory evolved to solve just one problem, appears at fault. There is little reason to believe that episodic memory would be tied to a single survival-relevant problem in our evolutionary history. In contrast, it seems logical that flexible and complex brain networks capable of solving a diverse array of problems would be more likely to survive natural selection compared to systems that solve only one problem. The distributed heteromodal cortical “real-estate” that comprises brain networks, like the one that supports episodic memory, carries a high metabolic cost (Raichle, 2010). As a result, this high cost is likely balanced by a flexible network that can serve numerous functions, providing many benefits and not just one.

This is consistent with what we know about episodic memory, which flexibly draws upon several more specific cognitive processes depending on the current goals and context. It is no coincidence that the episodic memory network bears similarity to so many other processes, including future thinking, theory-of-mind, narrative comprehension, and spatial navigation (Spreng, Mar & Kim, 2009). Even the shared network that likely underlies all these different processes, the default network, appears to consist of at least two interacting subsystems that broadly dissociate recollection from inference (Andrews-Hanna, Smallwood & Spreng, 2014). Although these processes are well-integrated and mutually informative, their presence and interaction are not consistent with a single monolithic function for episodic memory.

The varied social deficits experienced by those with compromised episodic memory is also inconsistent with the idea that episodic memory serves a single social function. Amnesic patients are not only likely to experience difficulty recalling single events, reducing the persuasive efficacy of testimony as predicted by the target article, but they also experience a multitude of other social deficits. This includes reduced empathy and helping behavior (Beadle et al., 2013) and smaller social network size (Davidson et al., 2013). Moreover, the hippocampus—a region central to episodic memory—has been found to be involved in encoding many forms of social information, such as the interaction of power and affiliation (Tavares et al., 2015) as well as social rank (Kumaran, et al. 2016). These findings are more congruent with the idea that episodic memory supports a wide variety of social functions including those unrelated to persuasion.

Based on this evidence, we believe that episodic memory is unlikely to have evolved solely to provide testimony for the purposes of persuasion. Rather, we propose a novel and alternative characterization: episodic memory evolved to bring incidental past information to mind in order to solve unanticipated survival-relevant problems. This is immensely useful for humans, who operate in complex and uncertain environments where problems cannot always be predicted and prepared for. Because we do not always know what information will be important in the future, directed attention alone cannot encode all that we will need to solve future problems. This is what makes episodic memory so powerful. By allowing us to

re-create experience through a combination of recollection and constructive processes, supported by reasoned inference and associations, we are able to bring far more of the past to bear on current problems than would be possible with deliberate encoding alone. This is a great asset for solving unexpected problems, both social and nonsocial in nature. For example, if we discover that a co-worker is upset with us when no associated transgression seems obvious, episodic memory allows us to re-play past interactions and search for possible causes. Even if you hadn't realized an error at the time, by re-experiencing these past interactions we may well discover some subtle gaffe from the past. Episodic memory also helps us solve non-social problems, such as finding a mis-placed smartphone by re-tracing one's steps. Importantly, in both examples, we have no idea that the key information is going to be useful in advance. However, episodic memory allows this information to be brought to mind through re-construction and re-experiencing, using inferences to fill in what was not encoded. Because episodic memory succeeds in reproducing a great deal of information that seems trivial at the time of encoding, when this information suddenly becomes relevant and important for a current problem it is now available through a process of re-construction and inference.

It is likely no coincidence that one of the most powerful mnemonic techniques for remembering a list of unrelated items is to imagine moving through a familiar space, placing these items throughout (the method of loci; Yates, 1966). This technique leverages the power of our episodic memory to embed trivial information within a rich context of associations involving temporal order, spatial context, and interaction with the self. In a sense, it reverse-engineers what our episodic memory is doing for us all the time: trying to remember as much as possible about our experience in case something becomes important later on. This ability is key for survival in the uncertain conditions within which we operate; we don't always know what information is going to be important later on.

In closing, we agree that episodic memory plays a central role in social cognition. In fact, the "social brain" appears more closely aligned with the episodic memory system than with the attentional or perceptual systems (Spreng & Andrews-Hanna, 2015). It makes sense that our social milieu is a primary reason why our environment is so uncertain, as our most relevant context involves autonomous agents who are naturally less predictable than the physical environment. That said, we believe it would be an error to conclude from this that episodic memory evolved to solve only social problems or just one particular social problem (i.e., testimony to persuade others).

## 12. References:

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