Routledge
Taylor & Francis Group

Philosophical Psychology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/cphp20

The mnemonic functions of episodic memory

Alexandria Boyle

To cite this article: Alexandria Boyle (2022) The mnemonic functions of episodic memory, Philosophical Psychology, 35:3, 327-349, DOI: 10.1080/09515089.2021.1980520

To link to this article: https://doi.org/10.1080/09515089.2021.1980520

Published online: 16 Sep 2021.

PHILOSOPHICAL PSYCHOLOGY
2022, VOL. 35, NO. 3, 327–349
https://doi.org/10.1080/09515089.2021.1980520

Routledge
Taylor & Francis Group

ARTICLE

The mnemonic functions of episodic memory

Alexandria Boyle [a,b]

[a]Leverhulme Centre for the Future of Intelligence, University of Cambridge, Cambridge, UK; [b]Center for Science and Thought, University of Bonn, Bonn, Germany

ABSTRACT

Episodic memory is the form of memory involved in remembering personally experienced past events. Here, I address two questions about episodic memory's function: what does episodic memory do for us, and why do we have it? Recent work addressing these questions has emphasized episodic memory's role in imaginative simulation, criticizing the mnemonic view on which episodic memory is "for" remembering. In this paper, I offer a defense of the mnemonic view by highlighting an underexplored mnemonic function of episodic memory – namely, its role in the encoding, storage and retrieval of the type of information more standardly associated with semantic memory. I argue that in healthy individuals, episodic memory plays a central role in the encoding, storage and retrieval of prototypically semantic information, analogous to the role played by mind palaces in the method of loci, and may have been selected on for this reason. This suggests new directions for studying episodic memory, particularly in nonhuman animals.

ARTICLE HISTORY
Received 24 July 2020
Accepted 9 September 2021

KEYWORDS
Memory; episodic memory; function; method of loci; mind palace; simulation

1. The functions of episodic memory

Episodic memory is the form of declarative memory involved in remembering personally experienced past events. When I recall falling in the garden as a child and skinning my knee, visualizing my surroundings in my mind's eye and mentally reliving the sharp pain I felt, I am retrieving an episodic memory. The term "episodic memory" was introduced by the psychologist Endel Tulving (1972, 2005), who distinguished it from another form of declarative memory – semantic memory. Semantic memory, broadly speaking, can be treated as a store of general knowledge about the world. When I recall that 49 is the square of 7, or that the capital of Burkina Faso is Ouagadougou, I'm retrieving a semantic memory.

This paper is concerned with two questions about episodic memory. First, what does episodic memory do for us? Second, why do we have it? These are questions about episodic memory's function, in two importantly distinct

CONTACT Alexandria Boyle asb69@cam.ac.uk Leverhulme Centre for the Future of Intelligence, 16 Mill Lane, Cambridge, CB2 1SB, United Kingdom

senses of function. The first is a question about its *causal role* function – that is, about the role that it plays in our cognitive lives. An answer to this question would explain how the activities of episodic memory contribute to the activities of the cognitive system(s) of which it's a part. The second is a question about its *etiological* function – a request for a causal story about how episodic memory came to be. This question is naturally addressed by appealing to evolutionary considerations – by considering what advantages episodic memory conferred on our ancestors, in virtue of which it was selected on and retained in our lineage.

A common-sense answer to both questions is: remembering! What episodic memory does is contribute to our overall capacity to remember things – to encode and store information which can later be retrieved. We have episodic memory because it enabled our ancestors to remember things, and the capacity to remember things conferred benefits in virtue of which it was selected on. My goal in this paper is to offer a defense of this common-sense view that episodic memory is "for" remembering – which, in what follows, I'll call "the mnemonic view".

A defense of the mnemonic view is in order because an increasingly prominent family of views in the philosophy and cognitive science of memory, "simulationism", departs from the idea that memory is "for" remembering.[1] Simulationist views differ from one another in various ways, including in respect of which notion of function they're most centrally concerned with. But at their core, they share a commitment to the claim that episodic memory's function is simulation: episodic memory contributes to our capacity to simulate hypothetical, counterfactual and/or future events. As a claim about the causal role function of episodic memory, the idea is that episodic memory provides the experiential details out of which alternative event simulations can be constructed (Schacter & Addis, 2007). As a claim about the etiological function of episodic memory, the idea is that in virtue of its role in event simulation, episodic memory conferred certain benefits on our ancestors – such as the capacity to plan for the future (Suddendorf & Corballis, 2007), or to make less impulsive decisions (Boyer, 2008) – as a result of which it was selected on.

Simulationism is sometimes presented as a competitor to the mnemonic view (see especially De Brigard, 2014). As such, part of the argument for simulationism consists in what Arieh Schwartz (2020) calls the "negative project", that is, making a case against the mnemonic view. Two key sources of evidence are marshaled in support of this negative project. First, it is argued that the mnemonic view fails to make sense of evidence that episodic memory is frequently inaccurate. Second, it is argued that the mnemonic view offers a worse explanation than simulationism of the evidence for neural overlap between tasks engaging episodic memory and those engaging imaginative simulation.

As Schwartz convincingly argues, this negative project fails. The appeal to memory errors rests on implausible claims about the degree of accuracy the mnemonic view commits one to. The view that memory's function is remembering is sometimes referred to as the "storehouse view". This invites the interpretation that on the mnemonic view, memory is a place for storing items, such that those very same items can be retrieved later – just as I can now retrieve the very box of lentils I put in my store cupboard earlier. Memory errors certainly put pressure on this view: what we retrieve from memory is rarely, if ever, an entirely faithful record of our original experience. But the storehouse metaphor is not the only way to cash out the mnemonic view. To say that the function of memory is remembering is to say that its function has to do with *memory*: the set of processes by which organisms encode, store and retrieve information. Since information is not like a box of lentils, there are various ways in which episodic memory might play a role in the encoding, storage and retrieval of information, other than by acting as a storehouse. Information might be transferred between different representational vehicles, and might even be transformed in various ways, and still "count" as having been encoded, stored and retrieved. And these processes – encoding, storage and retrieval – may make competing demands. As Sara Aronowitz (2019) argues, a memory system optimized for retrieval is unlikely to be one which faithfully stores all information encoded. In short, it is no part of the mnemonic view that episodic memory stores a perfectly faithful record of the past.

More importantly, it is not clear that the mnemonic view and simulationism *are* competitors – since an item can have more than one function, in either sense of function. Episodic memory might contribute to the operations of more than one cognitive system, and might have conferred diverse benefits on our ancestors, any number of which might have created selection pressure in its favor. And if this is so, no single function of episodic memory can be expected to account for all of its features. So, the impressive evidence in favor of simulationism, and the explanation it offers for neural overlap between memory and simulation processes, are no argument against the mnemonic view.

But whilst it's one thing to say that the mnemonic view is in principle compatible with the positive claims of simulationism, it's quite another to say why we should accept it. It is of course not enough to appeal to common sense. If the mnemonic functions of episodic memory are to be welcomed into the fold, alongside its role in simulation, the challenge is to explain what the mnemonic functions of episodic memory are – what role or roles it plays in our capacity to encode, store and retrieve information. In this paper, I respond to this challenge by offering a positive defense of the mnemonic view.

Just as "simulationism" picks out a broad family of views, the same is true of "the mnemonic view". The common thread running through mnemonic views is that episodic memory has mnemonic functions, in one or both senses of function. As a claim about causal role functions, the idea is that episodic memory contributes to our capacity to store, encode and retrieve information. As a claim about etiological functions, it is that it is in virtue of episodic memory's contributions to the storage, encoding and retrieval of information that we have it.

One might flesh out these ideas in a number of ways. Perhaps the most natural way to begin would be to focus on episodic memory's role in encoding, storing and retrieving the sort of information with which it's most centrally associated – information about personally experienced past events. There's clearly a case to be made for the view that episodic memory facilitates the encoding, storage and retrieval of this kind of information, and that this may have conferred benefits on our ancestors (see e.g., Boyle, 2019; Hoerl & McCormack, 2016; Mahr & Csibra, 2018). In this paper, though, I take a different approach. Whilst episodic memory is most obviously associated with information about past events, we can also view it in a broader context as a component of the declarative memory system, which interacts pervasively with semantic memory. Adopting this perspective provides for a more expansive view of its mnemonic functions – since the interactions between episodic and semantic memory indicate that, in addition to supporting the encoding, storage and retrieval of information about the past, episodic memory is also centrally involved in the encoding, storage and retrieval of the general knowledge about the world more commonly associated with semantic memory.

In discussing episodic memory's mnemonic functions in the remainder of this paper, I focus on this kind of information, which I'll call "prototypically semantic information". I argue that episodic memory plays a crucial role in the encoding, storage and retrieval of prototypically semantic information in healthy individuals, analogous to the role played by mind palaces in the mnemonic device known as the "method of loci". Moreover, although any account of its etiological functions can be at best preliminary, I argue that there is a case for thinking that this created selection pressure in its favor. As well as highlighting underexplored *semantic* mnemonic functions for episodic memory, worth taking seriously alongside its roles in simulation and memory for past events, I propose that this relationship between episodic memory and semantic information points toward new avenues for the study of episodic memory, particularly in nonhuman animals.

2. Episodic memory and semantic information

I begin in this section by focusing on the question of episodic memory's causal role function, arguing that episodic memory plays a crucial role in the encoding, storage and retrieval of prototypically semantic information.

As sketched above, the distinction between episodic and semantic memory approximates to the intuitive distinction between memory for events and memory for facts. As Tulving (1972, p. 387) notes, it is also roughly captured by the common sense distinction between things we remember (episodic memory), and things we simply know (semantic memory). That these intuitive distinctions mark a genuine psychological distinction is evidenced, among other things, by the fact that memory for events and memory for facts can, to some extent, be selectively impaired. Damage to the medial temporal lobes (MTL) causes loss of memory for events, whereas loss of factual memory is occasioned by damage to the neocortex. So, it's commonplace to treat these two forms of memory as distinct processes or systems. Memory for events is the province of episodic memory, and memory for facts is the province of semantic memory.

This thumbnail sketch of the distinction between episodic and semantic memory provides a useful heuristic for thinking about memory but is perhaps misleading. In emphasizing the ways in which episodic memory and semantic memory can be dissociated, it gives an impression of the two as entirely discrete and separate. But it is increasingly clear that their relationship is more complex than this sketch suggests.

For one thing, the distinction between episodic and semantic memory is notoriously difficult to draw in a clear, principled way. Whilst I've roughly captured it here in terms of the different kinds of information with which each is concerned, in reality both kinds of memory involve both sorts of information. One can semantically remember information about events – I remember (semantically) that I was once interviewed by a journalist, for instance, but don't remember (episodically) the interview. Episodic memory can also be used to retrieve prototypically semantic information – for instance, I can recall the French word for "toad" because I (episodically) remember my French teacher calling me a *crapaud paresseux*. And individual memories can sometimes present as a mixture of episodic and semantic components – I might dimly remember an event, draw on semantic memory to fill in some details, prompting the recollection of other details.

Moreover, as I explore in more detail below, whilst the dissociations mentioned above help to ground a distinction between episodic and semantic memory these dissociations are not clean. In healthy individuals, episodic and semantic memory systems interact and are interdependent. As I want to suggest in this section, these interactions reveal an underexplored

mnemonic function of episodic memory: episodic memory plays a role in the encoding, storage and retrieval of the factual information typically associated with semantic memory.

It's worth noting that whilst I focus here on episodic memory's role in semantic processes, there are no doubt further complex interactions between these two forms of memory. In particular, it's clear that semantic memory also plays a role in prototypically episodic processes. This role is hinted at by certain patterns of episodic memory error – for instance, semantic intrusions such as the DRM effect, in which subjects are prone to incorrectly report that they previously saw a word in a list when it is semantically related to words that were in the list (Deese, 1959; Roediger & McDermott, 1995). In addition, in semantic dementia, the ability to retrieve temporally remote episodic memories is impaired, as is the ability to episodically construct future scenarios (see Irish & Piguet, 2013 for review). This motivates the "semantic scaffolding hypothesis", according to which semantic memory provides a structure or scaffold facilitating both episodic memory retrieval and episodic future thought (Greenberg & Verfaellie, 2010; Irish et al., 2012). A full account of declarative memory would need to spell out the bidirectional relationships between the semantic and episodic systems. But since I am primarily concerned with the functions of episodic memory, I focus here only on *its* distinctive contributions to declarative memory – and more specifically, on its contributions to the encoding, storage and retrieval of prototypically semantic information.

That episodic memory plays a role in the encoding and storage of prototypically semantic information is suggested by studies of episodic amnesiacs – patients who have suffered damage to the medial-temporal lobes. This form of brain damage results in severe retrograde and anterograde deficits in episodic memory, suggesting that the MTL plays a critical role in the formation and storage of episodic memories. The effects of MTL damage on semantic memory are more complicated. Well-established semantic memories remain largely intact – indeed, this is part of the motivation for thinking of episodic and semantic memory as distinct forms of memory. But semantic memories acquired during the late premorbid period are affected, and new semantic learning is severely impaired (Manns et al., 2003). Although some semantic learning is possible, memories are in general slowly formed, hyper-specific and poorly integrated with the existing semantic knowledge base (Greenberg & Verfaellie, 2010, p. 749), and are not retrievable under the same conditions (Bayley et al., 2008, p. 581).[2]

It might be pointed out that this evidence, drawn from studies of adult-onset amnesia, stands in tension with the evidence about developmental amnesia. Some individuals have been able to achieve an impressive amount of semantic learning despite suffering MTL damage early in life (e.g., Vargha-Khadem et al., 1997). This might reasonably lead one to

doubt that the MTL is critically involved in semantic memory. But laboratory studies do reveal that the semantic learning of developmental amnesiacs differs importantly from that of healthy individuals: developmental amnesiacs learn "very slowly, require many exposures to the relevant information to support their recall, and fail to reach the standards of matched controls" (Elward & Vargha-Khadem, 2018, p. 29). This supports the idea that the MTL plays a critical role in the encoding and storage of prototypically semantic information in healthy individuals.

In addition to the encoding and storage of semantic memories, evidence from amnesia also suggests that episodic memory may play a role in the *retrieval* of prototypically semantic information. Although, as already noted, established semantic memories are largely spared in MTL amnesia, MTL amnesiacs do have deficits relative to healthy controls with respect to the *accessibility* of semantic information. For instance, MTL amnesiacs are impaired relative to healthy controls in tasks requiring exemplar generation – that is, naming examples of things from a given category. This impairment is worse when the category is one which, in healthy subjects, elicits an episodic retrieval strategy – for instance, a category like "things found in the kitchen" or "Italian food", which healthy individuals typically approach by remembering standing in their own kitchen or remembering visits to Italian restaurants. The experimenters conclude that the amnesic patients' episodic deficit impairs their capacity for semantic retrieval (Greenberg et al., 2009).

Similarly, healthy individuals display a range of performance advantages in tasks requiring speed reading or a judgment of fame about the names of famous individuals when the names are "autobiographically significant" – that is, statistically likely to be linked to an episodic memory for individuals in the subject's demographic. But MTL amnesiacs display no such performance advantage – again suggesting that their episodic memory deficits reduce the accessibility of semantic information (Westmacott et al., 2003).

Finally, Elward and Vargha-Khadem (2018, p. 28) found that developmental amnesiacs performed very badly compared to controls in a task requiring free recall of information that had been repeatedly presented on a video, recalling just 35% of the information. However, in a cued recall task for the same information, they scored markedly better – recalling 85% of the information presented. This suggests that although the semantic information had been acquired through repeated exposure, it was less accessible to the developmental amnesiacs than to the healthy controls, for whom the difference between free and cued recall tasks was less stark – presumably because they were able to use their episodic memories of the videos to cue retrieval of the target information.

This evidence is suggestive but falls short of establishing a role for episodic memory in semantic memory processes. Consistently with this evidence, it might be that the MTL plays a critical role in the encoding, storage and retrieval of semantic information but that this is independent of its role in the formation and maintenance of episodic memory. A more unified explanation would be that these are integrated functions: that "episodic memory facilitates the acquisition of new semantic memory as well as the transfer and consolidation of information into neocortical regions" (Greenberg & Verfaellie, 2010, pp. 749–750). But making this idea persuasive requires giving an account of *how* episodic memory could play such a role. Roughly speaking, an account of X's causal role function requires explaining how the activities of X contribute to the activities of some other system Y, of which it's a part. So, in addition to this suggestive neurological evidence, we need an account of how episodic memory could contribute to the encoding, storage and retrieval of prototypically semantic information.

Before that, it's worth anticipating a worry. I've suggested that episodic memory contributes to the encoding, storage and retrieval of prototypically semantic information, so I could perhaps be read as claiming that episodic memory is a part of semantic memory – and thereby pitting myself against the idea that these are distinct memory systems. As I've said, the individuation of episodic and semantic memory is not straightforward, but I don't mean to deny that the two can productively be treated as separate systems. Given the interactions between the two, though, we can also treat them as two constituents of an overarching declarative memory system. Viewed through this lens, my concern is to show that episodic memory has a causal role function in the capacity of the declarative memory system to encode, store and retrieve prototypically semantic information – that this is not the province of semantic memory alone.[3]

One influential picture of declarative memory motivated by the interactions between semantic and episodic memory takes it to be comprised of two "complementary learning systems" (McClelland et al., 1995; O'Reilly et al., 2014). On this approach, semantic memory is modeled as a connectionist learning system which learns the semantic or categorical structure of a domain gradually, by altering connection strengths between nodes in response to repeated exposures to information in the domain. But the formation of semantic memory *begins* with episodic memory: episodic memories provide "a medium for the initial storage of memories". The semantic memory system learns from the episodic memory system, as the replay of episodic memories provides the repeated exposures necessary for new semantic information to be gradually "incorporated into the structured system already contained in the neocortex" (McClelland et al., 1995, p. 435).

One advantage to employing these complementary systems is that, in computational models, attempting to integrate new information too rapidly into an exclusively semantic learning system can cause "catastrophic interference", that is, the complete overwriting of already existing knowledge (McClelland et al., 1995, p. 432). This interference can be eliminated if new information is incorporated gradually, through repeated exposures to novel information interleaved with exposures to other information in the same domain. Episodic memory allows for the initial storage of information "in a form that avoids interference". And by enabling the repeated simulation or "replay" of past events, it provides the repeated, interleaved exposures necessary for the new knowledge gradually to be "incorporated into the structured system already contained in the neocortex" (McClelland et al., 1995, p. 435).

So, it seems that by providing for the initial encoding and storage of prototypically semantic information, episodic memory facilitates interference-free integration of information into semantic memory. In addition to this, I want to suggest, the distinctive features of episodic memory confer a number of other mnemonic advantages when it comes to memory for prototypically semantic information. These can be made vivid by considering a well-known and highly effective mnemonic device known as the "method of loci".

The method of loci is a mnemonic device in which information is stored in a "mind palace". A mind palace is a detailed visual image of a familiar space – one's childhood home, or a route between two places one takes frequently, for example. "Storing" information involves placing images representing the to-be-remembered information at successive locations in the mind palace. For instance, suppose that I wish to remember the names of the fifty states of the USA, in decreasing order of geographic size. My first task will be to choose a mind palace. Let us suppose that, being familiar with the layout of my local IKEA, I choose that – since there is a determinate route to be taken through an IKEA store, from entrance to exit. Next, I visit the first "locus" in my mind palace: the car park. There I place an image representing Alaska – perhaps an image of Sarah Palin riding a polar bear. Next, I visit the second locus: the travellator leading up into the store. Here, I place an image representing Texas – a man in a ten-gallon hat, say. Then I go on to the third locus: the box of tiny pencils. Here I place a surfer eating a California roll, representing California. And so on, for all fifty states. Later, to retrieve the information, I take a mental "walk" through IKEA, retrieving the images I've placed at each location. Each image acts as a retrieval cue for the state it represents (Worthen & Hunt, 2011, pp. 69–70).

What is interesting about the method of loci from our perspective is that it combines episodic and semantic elements. On the one hand, the information typically stored and retrieved using the method of loci is of a kind

usually associated with semantic memory. Mind palaces are not usually used to remember details of events witnessed first-hand, but to recall pieces of more general knowledge – like the names of the fifty states, a sequence of cards, or π to a hundred decimal places.[4] On the other hand, unlike prototypical exercises of semantic memory, retrieval of information in the method of loci shares many of the features distinctive of episodic recollection.

The experience of episodic recollection, or "mentally reliving", has a number of characteristic features (discussed in Boyle, 2020b). First, mentally reliving a past event involves having mental imagery of that event, including visual mental imagery presenting us with a spatiotemporally organized environment. As a corollary of the mental imagery episodic recollection involves, it is also characterized by the encoding and retrieval of an abundance of information, including "incidental" information – that is, information which is irrelevant to the subject's goals at the time of encoding, and frequently also irrelevant at the time of retrieval. The mental imagery involved in episodic recollection is dynamic, in the sense that it *unfolds*, changing over time in a way that reflects the way the remembered event unfolded over time: the constituent temporal parts of remembered events are represented serially. In addition to this mentally reliving an event involves some self-representation: I represent my own involvement in the events and have the sense that I have this memory *because* I was present at the original event.

Storage and retrieval of information in the method of loci involves an experience of a very similar kind. It also involves rich mental imagery, since constructing and using a mind palace involves calling to mind a spatiotemporally organized visual mental image and populating it with further imagery. As in episodic recollection, this imagery encodes a wealth of information which is more or less irrelevant to the subject's goals. The aim is simply to remember an ordered list – but in order to do that, the method of loci requires individuals to remember a space, a route through the space, a series of images, and what it is each image represents. The imagery involved in use of the method of loci is also dynamic, since one mentally "visits" and "revisits" locations in the mind palace successively, one after the other, in order to store and retrieve stored information. As in episodic recollection, there is some self-representation: one represents oneself visiting each location, and retrieval is construed as dependent on an earlier experience: I can retrieve these things, because *I* placed them here before.

None of this is to say that uses of the method of loci *are* exercises of episodic memory in any straightforward sense. Whilst it's a difficult question just what qualifies something as an exercise of episodic memory, uses of the method of loci differ from paradigmatic exercises of episodic memory in

several important respects. First, individuals explicitly and deliberately "encode" to-be-remembered information in the method of loci, whereas one need not typically make any deliberate effort to encode information in episodic memory. Second, mind palaces are "reusable": an individual can clear one set of items out of their mind palace and repopulate it with new images in order to remember a new set of information. There's no clear analogue of this in ordinary exercises of episodic memory. Third, at least in prototypical instances of episodic memory (though perhaps not all instances (Boyle, 2020a)), one has the sense that one is remembering some particular past episode. But whilst retrieval in the method of loci does involve a sense of dependence on the past (I can retrieve these things *because* I put them here before) it need not involve remembering a particular past episode.

The important point for my purposes is that whilst it is centrally concerned with prototypically semantic information, the method of loci nevertheless shares many of episodic memory's distinctive features: it "takes semantic information and transposes it onto an episodic structure" (Aronowitz, 2018, p. 16). Specifically, like episodic memory, it is characterized by an experience of spatiotemporally organized dynamic mental imagery, incorporating both self-representation and a wealth of incidental information. In what follows, in speaking about the episodicity or episodic features of the method of loci, these are the features I have in mind.[5] My suggestion is that these episodic features of the method of loci are at least partly responsible for its effectiveness as a means for encoding, storing and retrieving prototypically semantic information – and so may also help to explain episodic memory's role in semantic recollection.[6]

First, certain ways of encoding information are known to promote the retrieval of that information later on. The method of encoding prescribed in the method of loci, in which information is attached to an episodic structure, seems to exploit many of these encoding techniques.

For instance, elaborative encoding is known to promote the retrieval of information. That is, one is more likely to remember information if, rather than simply attempting to commit *only* that information to memory, one supplements it at the time of encoding with additional details – for example, by connecting it to other ideas or facts, by drawing or paraphrasing it or in some other way (Lockhart & Craik, 1972; Wammes et al., 2017). It is clear that the method of loci exploits this in virtue of its episodic features. It is essential to the method that, rather than attempting simply to encode the target information, one elaborates on that information by generating mental images associated with each piece of information, and locating them within a more elaborate imagined episode (Worthen & Hunt, 2011, p. 72).

Integrating information into a single spatiotemporally structured representation likely also promotes remembering in a number of ways. Locating information within a structured representation improves its memorability,

since organized information is easier to recall than non-organized information (Worthen & Hunt, 2011, p. 57). Many mnemonic devices involve attaching to-be-remembered information to organizational structures for this reason. For example, in the peg-word method, one memorizes a rhyme connecting a sequence of numbers with "peg" objects, before using mental imagery to connect the to-be-remembered information to the peg objects. The method of loci makes use specifically of a spatiotemporal organizational principle, rather than a verbal or numeric one. It's been suggested that the success and longevity of this method due is to this use of spatiotemporal structure, reflecting a "natural human proclivity to use spatial context [. . .] as one of the most effective means to learn and recall information" (Maguire et al., 2003). Moreover, locating the to-be-remembered semantic information within a single, spatiotemporally structured representation, the method of loci consolidates the information into a single, meaningful unit, which likely facilitates retrieval of the whole (Worthen & Hunt, 2011, p. 73). Further, imaginatively simulating *oneself* placing the images within a familiar space may increase the extent to which the information is encoded as self-related, possibly promoting retrieval by way of the self-reference effect – that is, the greater tendency to remember self-related information (Brown et al., 1986; Symons & Blair, 1997).

Second, retrieval of information from memory is generally more likely given an appropriate cue. Cues can be external, being provided by something in the world, or internal, provided by something in the mind of the individual. The method of loci, in common with many other mnemonic devices, furnishes individuals with the ability to generate an internal cue for retrieving target information – namely, the mind palace, and the images placed within it.

Memory cues vary in their effectiveness in some systematic ways. According to the influential "encoding specificity" principle (Tulving & Thomson, 1973), cues will be more effective to the degree that they create contextual overlap between encoding and retrieval. If one learns a set of words in a particular environment, for instance, one's retrieval of those words will be better in that environment, or in a similar one, than elsewhere (Godden & Baddeley, 1975). The method of loci creates a high degree of contextual overlap between encoding and retrieval: both encoding and retrieval involve mentally "visiting" one's visualized mind palace, an imaginatively simulated environment common to both stages – and it is likely that this encoding-retrieval match also plays a role in its effectiveness.

Nairne (2002) argues that, more so than the encoding-retrieval match, successful retrieval is predicted by the "diagnostic value" of the retrieval cue – that is, "the extent to which the retrieval cue uniquely specifies the target" (Goh & Lu, 2012, p. 29). The thought is that a cue will be less effective in retrieving a piece of information to the extent that it is equally associated

with other salient pieces of information. If you are trying to remember the name of somebody you met at a conference, it will not help to recall that she was a philosopher, if all the other delegates were philosophers. But it might help to be reminded that she was from Manchester, or that she gave a talk on determinism, if these things pick her out more uniquely. The method of loci exploits this feature of memory by producing a highly distinctive retrieval cue for each piece of information (Worthen & Hunt, 2011, p. 56). Since each piece of information is represented by a unique image, the resulting cues are highly distinctive from one another. In their combination with the context of the mind palace, they are often also highly distinctive relative to anything else in one's experience: whilst I have seen Sarah Palin, polar bears and the IKEA car park before, I have never seen the three in combination other than in my mind palace, representing Alaska. Being so distinctive, the cues presented in a mind palace have a high diagnostic value, and this is likely central to the method's effectiveness.

In sum, the method of loci is an extremely effective technique for remembering semantic information, and it seems to be so effective in virtue of exploiting many of the distinctive features of episodic memory. Integrating information into a meaningful representation involving spatio-temporally organized mental imagery, elaborating it with an abundance of extraneous detail and, through imaginative simulation, connecting it with oneself are hallmarks of episodicity. And these features also seem to be at least partly responsible for the method of loci's effectiveness, enabling its users to encode information in an elaborated, structured and self-related fashion, and providing them with retrieval cues which are both highly distinctive and induce a high degree of encoding-retrieval match.

Again, the purpose of this discussion is not to claim that uses of the method of loci *are* examples of episodic memory at work. Rather, it is to highlight that the device seems to be effective, at least in part, in virtue of features it shares with episodic memory – that these episodic features confer an advantage in the domain of semantic recollection. This allows us to make progress with the question I raised above – namely, how episodic memory might contribute to the encoding, storage and retrieval of prototypically semantic information – since it suggests several ways in which episodic memory's distinctive features might enable it to play such a role.

First, like mind palaces, episodic memories provide a spatiotemporally structured framework within which information can be encoded and stored when first presented, and spatiotemporally structured information is more easily remembered. Second, encoding semantic information in the context of the event in which it was acquired provides it with a degree of elaboration, by associating it with other features of the event. Importantly, this is a kind of elaboration that is available without requiring one immediately to locate the new information within one's existing semantic knowledge structures –

which, as noted above, can lead to catastrophic interference. Further, as in the method of loci, associating semantic information with its episodic context may exploit the self-reference effect, since it involves encoding the relationship between the information and an event in which one was personally involved. All of these features of episodic encoding seem likely to promote the retrieval of the relevant semantic information.

In addition, like mind palaces, episodic memories provide a strategy for the retrieval of semantic information in virtue of its episodic features. Episodic memory encodes associations between pieces of prototypically semantic information and the events during which they were acquired. As long as the relevant episodic memories are retained, they can be called upon to provide an internal cue for the retrieval of information initially associated with the relevant events. The internal cues provided by episodic memories are likely to be effective for a number of reasons. Like mind palaces, episodic memories provide for a high degree of contextual overlap between the contexts of encoding and retrieval – since the retrieval cue is a "mental reliving" of the context of encoding. So, the cues provided by episodic recollection capitalize on the encoding-retrieval match. They will also often be highly distinctive, since episodic memories pick out specific past events, and so are likely to have high diagnostic value for the associated semantic information.

This discussion suggests that a plausible explanation for the evidence discussed at the beginning of this section, about how MTL damage impairs semantic processing, is that episodic memory functions to support the encoding, storage and retrieval of prototypically semantic information, in a number of ways. Semantic information is first encoded in episodic memory in the context of the event in which it was encountered, and initially stored in the MTL. Repeated offline replays of the event allow for interference-free consolidation into neocortical areas. In the meantime, and even after the semantic information is consolidated into the neocortex, the episodic memory continues to furnish the subject with a way of accessing the relevant information, by providing internal cues for its retrieval.

3. Origins

So far, I have been focused on the question of episodic memory's causal role function. But the considerations offered here also provide *prima facie* reason for thinking that episodic memory conferred distinctive and significant advantages on our ancestors in the domain of remembering, and so form the basis of a preliminary case for its etiological function.

This account can only be preliminary, for two reasons. First, to assign a cognitive entity an etiological function is to explain how its contributions to our ancestors' fitness drove selection in its favor. To ask this question

about episodic memory is to assume that it *has* an etiological function: that we have episodic memory because it conferred benefits on our ancestors in virtue of which it was selected on. But not all traits have an etiological function in this sense. Some are to be explained in terms of nonselective processes such as developmental constraint and genetic drift; others are spandrels – by-products of adapted traits, with no function of their own. Whilst the assumption that episodic memory is an evolved trait with an etiological function is widespread (Boyle, 2020b; De Brigard, 2014; Klein et al., 2010; Suddendorf & Corballis, 2007; Tulving, 2005), a range of other views about its origins are in principle available and nothing in this paper rules them out.

Second, even if we assume that episodic memory has an etiological function, we can have only limited confidence in an account of its function. Ideally, making a case for the etiological function of a cognitive trait would require identifying selection pressures facing the population in which it emerged to which the trait would have been a more cost-effective solution than any available alternative. In practice, we are quite far from a consensus on the phylogenetic distribution of episodic memory, making it impossible to identify the relevant ancestral population.[7] Relatedly, it is less than clear what the available alternatives would have been, and so difficult to compare the benefits conferred by episodic memory in any domain with relevant alternatives. As a result, no account of episodic memory's etiological function can properly satisfy the norms governing etiological explanation of this kind and can only be preliminary.

Notwithstanding these limitations, if we are prepared to assume that episodic memory has an etiological function, some accounts of this function will be more plausible than others. In general, accounts will be plausible to the extent that they identify benefits episodic memory could plausibly have conferred, given what we know about it, in response to pressures some relevant ancestral populations might plausibly have faced.

That episodic memory may have conferred benefits on our ancestors in the domain of semantic learning and memory is suggested by the evidence of MTL amnesia, which indicates that semantic encoding, storage and retrieval are significantly dependent on episodic memory. Although semantic learning is possible in the absence of episodic memory, it is slow, hyperspecific, and poorly integrated. Moreover, episodic memory provides a distinctive strategy for the retrieval of semantic information, with the result that information is more readily retrievable by individuals with both episodic and semantic memory than by individuals with semantic memory alone. This provides a *prima facie* reason for thinking that whatever selection pressures have favored semantic memory – that is, a capacity to store and retrieve general information about the world – may concurrently have selected for episodic memory, on which semantic memory seems to depend.

One might object that amnesia provides an imperfect lens through which to view the mnemonic capacities of our ancestors. We cannot assume that, if our ancestors lacked episodic memory, their semantic memory capacities would have been as impoverished as those of MTL amnesiacs. Particularly when it comes to adult-onset amnesia, it might be that many of the observed semantic limitations are due to developmental factors: that if episodic memory had been absent all along in these individuals, their semantic memory would have developed differently in order to pick up the slack, and that a lack of neural plasticity is what prevents it from doing so now. If this were right, it would undermine the idea that episodic memory made a differential contribution to fitness in virtue of its contributions to memory.

However, two sources of evidence already appealed to in above suggest that the dependence of semantic memory on episodic memory is not a developmental artifact. First, although some developmental amnesiacs have achieved a surprising amount of semantic learning, their semantic learning and retrieval nevertheless remain deficient. They learn slowly and only after many exposures, never reach the standard of matched controls, and perform poorly on tasks requiring free recall of information. So, although they may have benefited from developmental plasticity, their semantic deficits nevertheless support the idea that episodic memory makes significant mnemonic contributions to the efficiency, reliability and accessibility of semantic learning. Second, prominent theoretical accounts of semantic memory suggest that without something like episodic memory to provide both an initial storage medium for information and a facility for repeatedly exposing semantic memory structures to that information, semantic memory would be vulnerable to catastrophic interference. Again, if this is right, it suggests that the dependence of semantic memory on episodic memory is constitutive, and not merely developmental: that episodic memory solves a problem presented by semantic memory's basic mode of operation.

Of course, solving a problem is not sufficient for being selected on, since the costs of a solution might outweigh its benefits, or cheaper solutions might be available. It is difficult to evaluate the cost of episodic memory relative to alternatives, particularly without knowing what the alternatives are. But one thought that suggests episodic memory might not have been a very costly solution is that it makes use of hippocampal structures which are generally agreed to be evolutionarily old, and which may initially have been specialized for a similar function: the construction and maintenance of cognitive maps in support of navigation (Buzsáki & Moser, 2013; O'Keefe & Nadel, 1978). Generating spatiotemporally structured episode representations does not seem a radical departure from this navigational function. So,

the emergence of episodic memory may not have required the creation of neural structures *de novo*, rather co-opting existing neural structures engaged in relevantly similar tasks.

The above consequently suggests a picture according to which selection favored the development of semantic and episodic memory in parallel. Episodic memory would have provided for substantially better semantic learning, in virtue of providing a medium for the initial encoding and storage of semantic information, in a form allowing for its gradual integration into semantic memory. The resulting episodic memories also provide a strategy for retrieving this information, increasing its accessibility even in the absence of external cues or internally generated semantic cues.

Other epistemic advantages are likely also to follow from possessing episodic memory in addition to semantic memory. For instance, the ability to encode prototypically semantic information by indexing it to an event, without immediately locating it within one's existing web of semantic knowledge might expand one's opportunities for learning. As I've argued elsewhere (Boyle 2019), if one can store memories of events, one can revisit those events and extract important information from them later – including information whose significance has only become apparent in the interim, in the light of more recently acquired knowledge. In this way, episodic memory uniquely makes it possible to learn from events retrospectively. If the view offered in this paper is correct, we should expect episodic memory to confer this advantage precisely because it provides a means to encode and store semantic information prior to its integration in semantic memory.

Naturally, I don't claim that the above constitutes a knock-down argument for the view that selection favored the emergence of episodic memory at least partly in virtue of its contributions to semantic learning and memory. As I've said, providing a conclusive argument is probably impossible. Nevertheless, I think that the above arguments constitute a persuasive preliminary case for the view that – if episodic memory is an adapted trait – it has a mnemonic etiological function in virtue of its role in the encoding, storage and retrieval of prototypically semantic information.

4. Conclusion

In this paper, I have defended a version of the view that episodic memory has mnemonic functions, in both the causal role and etiological senses of function. Specifically, I have argued that episodic memory plays a crucial role in the encoding, storage and retrieval of prototypically semantic information analogous to the role played by a mind palace in the method of loci: it provides a framework for the initial encoding of such information, and strategies for its retrieval.

In making this argument, I do not mean to suggest that this is episodic memory's only function, or even its only mnemonic function. As noted above, one might also defend the mnemonic view by pointing to episodic memory's role in the encoding, storage and retrieval of information about past events. And in addition to its mnemonic functions, episodic memory may also contribute to the operations of other cognitive systems and have conferred other selection-relevant benefits on our ancestors. In particular, as I noted above, I take it that this account is compatible with simulationist views on which episodic memory plays a role in our capacity to simulate hypothetical, counterfactual and future events, and was selected on for this reason.

In addition, it seems likely that episodic memory makes important contributions in other domains, besides memory and simulation. For instance, Hoerl and McCormack (2016), for instance, have argued that by providing memories of specific past events, episodic memory enables individuals to feel regret. Regret, in turn, facilitates better decision making – since individuals who are capable of experiencing and anticipating regret will make decisions with the possibility of regret in view. Mahr and Csibra (2018) have argued that the first personal event memories provided by episodic memory play an important role in socio-communicative practices, by providing speakers with access to the warrants for their assertions. And, as mentioned above, I've previously argued (Boyle 2019) that by storing memories of past events, episodic memory makes it possible to learn retrospectively, by enabling individuals to revisit and reinterpret events after they've occurred, in the light of new information. These accounts of episodic memory's function are consistent with the account offered here: in addition to playing a role in the encoding, storage and retrieval of semantic information, episodic memory may also facilitate regret, underwrite socio-communicative practices and support retrospective learning. And these roles for episodic memory may all have created selection pressure in its favor at various points in its history.

Although the three accounts just mentioned might be classified as mnemonic accounts, in the sense that they identify contributions episodic memory makes to various cognitive operations in virtue of its role in the encoding, storage and retrieval of information, they differ from the account offered here in an important sense. Although these accounts highlight ways in which episodic memory contributes to other cognitive operations in virtue of its mnemonic features, the operations to which it contributes on these accounts are not themselves mnemonic – instead having to do with emotion, decision making, communication and inference. By contrast, the account offered here highlights the contributions episodic memory makes to the wider memory system of which it's a part – declarative memory. As

such, this is a mnemonic account in a more robust sense, emphasizing episodic memory's contributions to the organism's overall capacity to learn and remember.

As I've said, the role played by episodic memory in our capacity to encode, store and retrieve semantic information need not undermine the view of episodic and semantic memory as distinct systems, or distinct components of declarative memory. However, it does rule out treating them as entirely independent, and reflection on the interactions between the two may suggest new approaches to the study of episodic memory. In particular, given the role played by claims about the function of psychological traits in comparative psychology (Boyle, 2019), this account of episodic memory's function points toward new methods for detecting episodic memory in animals.

Detecting episodic memory in animals is a controversial business for a number of reasons – but fairly high on the list is the apparent impossibility of devising a test that uniquely isolates episodic memory, as distinct from semantic memory. A reasonable assumption is that a convincing test for episodic memory must be such that it could not be "solved" by semantic memory alone. But since semantic memory is topic neutral, and can store information of virtually any kind, it can be difficult to conceive of a test that uniquely singles out episodic memory.

The account of episodic memory offered in this paper suggests a response to this worry. Episodic and semantic memory are functionally interrelated, such that episodic memory plays a time-limited but critical role in semantic encoding and short-term maintenance, along with a less critical but more lasting role in semantic retrieval. This means that it may be easier than it seems to construct a convincing test for episodic memory. Certain achievements of semantic memory, like rapid integration of new information into an existing knowledge base without catastrophic interference, seem to be possible only given that episodic memory is operational. Given an adequate account of these relationships between episodic and semantic memory we could in principle derive predictions about the respects in which semantic memory would be limited in animals, if they lacked episodic memory. Armed with such hypotheses, it would be possible to test the hypothesis that animals have episodic memory indirectly, without devising any tests which uniquely tap into episodic recollection. Of course, implementing this idea would require articulating precise hypotheses and devising appropriate methods for testing them – a substantial task, which I won't begin to attempt here. But if the argument of this paper is correct, then this work could be fruitful. Unexpectedly, it might be that the right kind of test for semantic memory provides the strongest evidence that episodic memory exists in nonhuman animals.[8]

Notes

1. Representatives of this simulationist family include (Boyer, 2008; De Brigard, 2014; Michaelian, 2016; Schacter & Addis, 2007; Suddendorf & Corballis, 2007).
2. Sharon et al. (2011) report rapid acquisition of semantic knowledge in MTL amnesiacs when a fast-mapping procedure is used. Smith et al. (2014) failed to replicate these results. If the results are replicable, this suggests that episodic memory is not *essential* for rapid integration of information into semantic memory. But it is consistent with this that episodic memory plays a critical role in the formation of semantic memories in healthy individuals.
3. Whilst I appeal primarily to contemporary evidence in support of this idea, it's worth noting that Aristotle arguably thought of the relationship between episodic and semantic memory in this way (see Annas, 1995). Thanks to a reviewer for highlighting this.
4. In some cases, one might use the method of loci to remember information about a particular event – e.g., the order in which a deck of cards was presented on a specific occasion. But the focus here is on retaining the semantic information rather than any other contextual details about the event.
5. For the avoidance of confusion, it's worth highlighting that different people use the terms 'episodic' and 'episodicity' in different ways. I use these terms broadly to refer to any features that distinguish episodic memory from other forms of memory (see, e.g., Michaelian & Sutton, 2017). Others instead use these terms to refer more narrowly to the way that episodic memories relate to particular past *episodes* (see, e.g., Martin, 2001). In speaking of the episodic features of the method of loci, I don't mean to suggest that it is episodic in this second, narrower sense.
6. Aronowitz (2018) also argues, for related reasons, that the method of loci should inform accounts of episodic memory's function.
7. Views on this range from the claim that episodic memory is uniquely human (Suddendorf & Corballis, 2007), to the idea that it is evolutionarily old and widespread (Allen & Fortin, 2013), to the view that it may have evolved convergently in a number of lineages (Emery & Clayton, 2004).
8. Earlier versions of this work were presented to audiences in Antwerp, Athens, Cambridge, Grenoble, London and York. I'm grateful to those present for their comments and questions, which helped to shape the paper. Thanks also to Richard Holton and Sarah Robins for comments on an earlier draft, and to two reviewers for this journal for invaluable feedback.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributor

Alexandria Boyle is a Research Associate in Kinds of Intelligence at the University of Cambridge and the University of Bonn. She specialises in the philosophy of mind and cognitive science.

ORCID

Alexandria Boyle http://orcid.org/0000-0001-8827-5479

References

Allen, T. A., & Fortin, N. J. (2013). The evolution of episodic memory, *Proceedings of the National Academy of Sciences Jun 2013*, *110* (Supplement 2), 10379–10386. https://doi.org/10.1073/pnas.1301199110

Annas, J. (1995). Aristotle on memory and the self. In M. C. Nussbaum & A. O. Rorty (Eds.), *Essays on Aristotle's De Anima* (pp. 297–312). Oxford University Press. https://doi.org/10.1093/019823600x.001.0001

Aronowitz, S. (2018). Retrieval is central to the distinctive function of episodic memory. Behavioral and Brain Sciences, 41, E2. https://doi.org/10.1017/S0140525X17001248

Aronowitz, S. (2019). Memory is a modeling system. Mind & Language 34(4), 2019, 483–502. https://doi.org/10.1111/mila.12220

Bayley, P. J., O'Reilly, R. C., Curran, T., & Squire, L. R. (2008). New semantic learning in patients with large medial temporal lobe lesions. *Hippocampus*, *18*(6), 575–583. https://doi.org/10.1002/hipo.20417

Boyer, P. (2008). Evolutionary economics of mental time travel? *Trends in Cognitive Sciences*, *12*(6), 219–224. https://doi.org/10.1016/j.tics.2008.03.003

Boyle, A. (2019). Learning from the past: Epistemic generativity and the function of episodic memory. *Journal of Consciousness Studies*, *26*(5–6), 242–251. https://doi.org/10.17863/CAM.35867

Boyle, A. (2020a). Remembering events and representing time. *Synthese*. https://doi.org/10.1007/s11229-020-02896-6

Boyle, A. (2020b). The impure phenomenology of episodic memory. *Mind & Language*, *35* (5), 641–660. https://doi.org/10.1111/mila.12261

Brown, P., Keenan, J. M., & Potts, G. R. (1986). The self-reference effect with imagery encoding. *Journal of Personality and Social Psychology*, *51*(5), 897–906. https://doi.org/10.1037/0022-3514.51.5.897

Buzsáki, G., & Moser, E. I. (2013). Memory, navigation and theta rhythm in the hippocampal-entorhinal system. *Nature Neuroscience*, *16*(2), 130–138. https://doi.org/10.1038/nn.3304

De Brigard, F. (2014). Is memory for remembering? Recollection as a form of episodic hypothetical thinking. *Synthese*, *191*(2), 155–185. https://doi.org/10.1007/s11229-013-0247-7

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. Journal of Experimental Psychology, *58*(1), 17-22. https://doi.org/10.1037/h0046671

Elward, R. L., & Vargha-Khadem, F. (2018). Semantic memory in developmental amnesia. *Neuroscience Letters*, *680*(October2017), 23–30. https://doi.org/10.1016/j.neulet.2018.04.040

Emery, N. J., & Clayton, N. S. (2004). The mentality of crows: Convergent evolution of intelligence in corvids and apes. *Science*, *306*(5703), 1903–1907. https://doi.org/10.1126/science.1098410

Godden, D. R., & Baddeley, A. D. (1975). Context-dependent memory in two natural environments: Land and underwater. *British Journal of Psychology*, *66*(AUG), 325–331. https://doi.org/10.1111/j.2044-8295.1975.tb01468.x

Goh, W. D., & Lu, S. H. X. (2012). Testing the myth of the encoding-retrieval match. *Memory & Cognition*, *40*(1), 28–39. https://doi.org/10.3758/s13421-011-0133-9

Greenberg, D. L., Keane, M. M., Ryan, L., & Verfaellie, M. (2009). Impaired category fluency in medial temporal lobe amnesia: The role of episodic memory. *Journal of Neuroscience*, *29*(35), 10900–10908. https://doi.org/10.1523/JNEUROSCI.1202-09.2009

Greenberg, D. L., & Verfaellie, M. (2010). Interdependence of episodic and semantic memory: Evidence from neuropsychology. *Journal of the International Neuropsychological Society*, *16*(5), 748–753. https://doi.org/10.1017/S1355617710000676

Hoerl, C., & McCormack, T. (2016). Making decisions about the future: Regret and the cognitive function of episodic memory. In K. Michaelian, S. B. Klein, & K. Szpunar (Eds.), *Seeing the future: Theoretical perspectives on future-oriented mental time travel* (pp. 241–266). Oxford University Press. https://doi.org/10.1093/acprof

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

Irish, M., & Piguet, O. (2013). The pivotal role of semantic memory in remembering the past and imagining the future. *Frontiers in Behavioral Neuroscience*, *7*(MAR), 1–11. https://doi.org/10.3389/fnbeh.2013.00027

Klein, S. B., Robertson, T. E., & Delton, A. W. (2010). Facing the future: Memory as an evolved system for planning future acts. *Memory & Cognition*, *38*(1), 13–22. https://doi.org/10.3758/MC.38.1.13

Lockhart, R. S., & Craik, F. I. M. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Maguire, E. A., Valentine, E. R., Wilding, J. M., & Kapur, N. (2003). Routes to remembering: The brains behind superior memory. *Nature Neuroscience*, *6*(1), 90–95. https://doi.org/10.1038/nn988

Mahr, J. B., & Csibra, G. (2018). Why do we remember? The communicative function of episodic memory. *Behavioral and Brain Sciences*, *41*, 1–16. https://doi.org/10.1017/S0140525X17000012

Manns, J. R., Hopkins, R. O., & Squire, L. R. (2003). Semantic memory and the human hippocampus. *Neuron*, *38*(1), 127–133. https://doi.org/10.1016/S0896-6273(03)00146-6

Martin, M. G. F. (2001). Out of the past: Episodic recall as retained acquaintance. In C. Hoerl & T. McCormack (Eds.), *Time and memory: Issues in philosophy and psychology* (pp. 257–284). Oxford University Press. http://books.google.com/books?hl=en&id=fXJhAAAAQBAJ&oi=fnd&pg=PA257&dq=Out+of+the+past:+Episodic+recall+as+retained+acquaintance&ots=WM98i1mxXw&sig=VwjMUD3m6OD_4C98i907-ulkYcE

McClelland, J. L., McNaughton, B. L., & O'Reilly, R. C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review*, *102*(3), 419–457. https://doi.org/10.1037/0033-295X.102.3.419

Michaelian, K. (2016). *Mental time travel: Episodic memory and our knowledge of the personal past*. The MIT Press.

Michaelian, K., & Sutton, J. (2017). Memory. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Summer2017.), https://plato.stanford.edu/archives/sum2017/entries/memory/

Nairne, J. S. (2002). The myth of the encoding-retrieval match. *Memory*, *10*(5–6), 389–395. https://doi.org/10.1080/09658210244000216

O'Keefe, J., & Nadel, L. (1978). *The hippocampus as a cognitive map*. Oxford University Press.

O'Reilly, R. C., Bhattacharyya, R., Howard, M. D., & Ketz, N. (2014). Complementary learning systems. *Cognitive Science*, *38*(6), 1229–1248. https://doi.org/10.1111/j.1551-6709.2011.01214.x

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*(4), 803-814. https://doi.org/10.1037/0278-7393.21.4.803

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: Biological Sciences*, *362*(1481), 773–786. https://doi.org/10.1098/rstb.2007.2087

Schwartz, A. (2020). Simulationism and the function(s) of episodic memory. *Review of Philosophy and Psychology*, *11*(2), 487–505. https://doi.org/10.1007/s13164-020-00461-1

Sharon, T., Moscovitch, M., & Gilboa, A. (2011). Rapid neocortical acquisition of long-term arbitrary associations independent of the hippocampus. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(3), 1146–1151. https://doi.org/10.1073/pnas.1005238108

Smith, C. N., Urgolites, Z. J., Hopkins, R. O., & Squire, L. R. (2014). Comparison of explicit and incidental learning strategies in memory-impaired patients. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(1), 475–479. https://doi.org/10.1073/pnas.1322263111

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*(3), 299–351. https://doi.org/10.1017/S0140525X07001975

Symons, C. S., & Blair, T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin*, *121*(3), 371–394. https://doi.org/10.1037/0033-2909.121.3.371

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–402). Acadmic Press.

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe (Eds.), *The Missing Link in Cognition* (pp. 4–56). Oxford University Press.

Tulving, E., & Thomson, D. (1973). Enoding specificity and retrieval processing in episodic memory. *Psychological Review*, *80*(5), 352–373. https://doi.org/10.1037/h0020071

Vargha-Khadem, F., Gadian, D. G., Watkins, K. E., Connelly, A., Van Paesschen, W., & Mishkin, M. (1997). Differential effects of early hippocampal pathology on episodic and semantic memory. *Science*, *277*(5324), 376–380. https://doi.org/10.1126/science.277.5324.376

Wammes, J. D., Meade, M. E., & Fernandes, M. A. (2017). Learning terms and definitions: Drawing and the role of elaborative encoding. *Acta Psychologica*, *179*(March2016), 104–113. https://doi.org/10.1016/j.actpsy.2017.07.008

Westmacott, R., Black, S. E., Freedman, M., Moscovitch, M., Black, S. E., Freedman, M., & Moscovitch, M. (2003). The contribution of autobiographical significance to semantic memory: Evidence from Alzheimer's disease, semantic dementia, and amnesia. *Neuropsychologia*, *42*(1), 25–48. https://doi.org/10.1016/S0028-3932(03)00147-7

Worthen, J. B., & Hunt, R. R. (2011). *Mnemonology: Mnemonics for the 21st century*. Psychology Press. https://doi.org/10.4324/9780203834107