

What has episodic memory got to do with space and time?

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It is widely held that episodic memory is constitutively connected with space and time. In particular, many contend that episodic memory constitutively has spatial and/or temporal content: for instance, necessarily representing a spatial scene, or *when* a given event occurred, or at the very minimum that it occurred in the past.¹ Here, I critically assess such claims. I begin with some preparatory remarks on the nature of episodic memory. I then ask: How, if at all, is episodic memory constitutively spatial? And, how, if at all, is episodic memory constitutively temporal? In answer, I argue that episodic memory need not have any spatial content, nor (in any substantial sense) need it represent *when* its events occur, nor even that they occur in the past. Instead, only a relatively modest connection holds between episodic memory and time in virtue of the temporal structure of its objects. Finally, I critically assess whether considerations concerning the organization and encoding of episodic memory in creatures like us provide stronger reason to posit a constitutive link between our episodic memories and space or time.

What is episodic memory?

Very broadly, we can distinguish two approaches to episodic memory. The first introduces episodic memory by way of a contrast. The second introduces episodic memory directly. Both

¹ By a constitutive connection I mean a connection that cannot fail to hold (i.e., holds essentially) since it is part of what it is to be the kind in question (cf. Burge 2010: xiii-xv, Chpts 1 and 3). Thus, to claim that episodic memory constitutively has spatial content is to claim that it is part of what it is for a state or episode to be (or count as) an episodic memory that it possesses spatial content. Such claims assume that the mind can be divided into kinds with distinct natures and that episodic memory is one such kind. I adopt this assumption in what follows.

approaches are found in Endel Tulving’s classic paper, ‘Episodic and semantic memory’. There, Tulving begins by noting Ross Quillian’s (1966) introduction of the term ‘semantic memory’, before asking: ‘What do we contrast with semantic memory?’ Tulving then proposes that we ‘refer to this other kind of memory, the one that semantic memory is not, as “episodic memory”’ (1972: 384). Alan Baddeley similarly comments that early talk of episodic memory was typically contrastive: ‘In its initial years ... the term episodic memory was commonly used to refer to all [explicit] memory other than semantic or working memory’ (2002: 5). Here, I raise a few questions about this *contrastivist* approach, on which the contrast with semantic memory takes primacy in determining the extension of the term ‘episodic memory’ (see Figure 1).

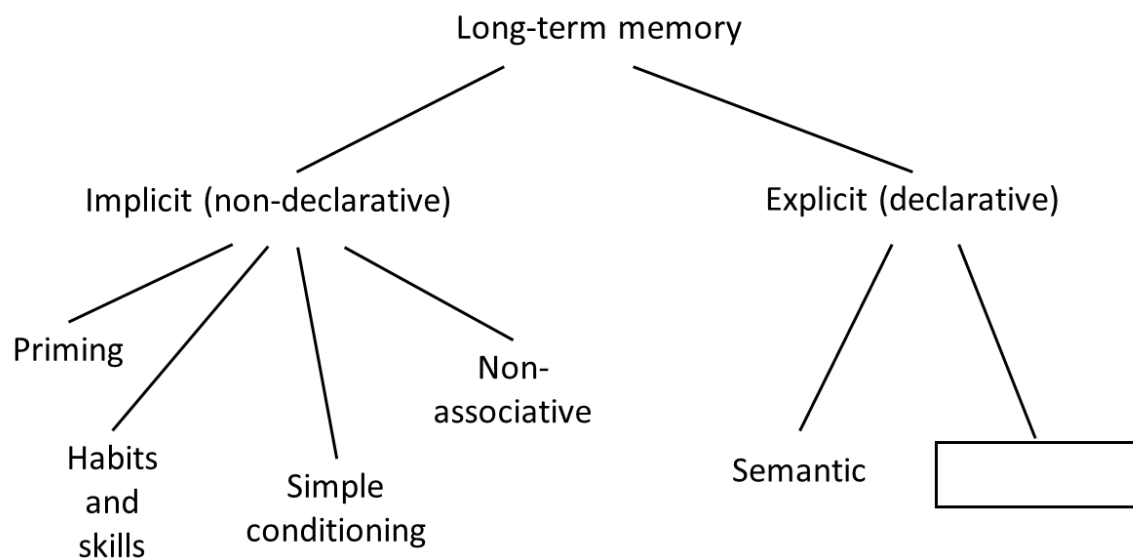


Figure 1. A standard taxonomy of the subdivisions of long-term memory based on Squire (1992), see likewise Hampton & Schwartz (2004). According to contrastivism, episodic memory is simply whatever memory belongs in the box on the righthand side, i.e., explicit/declarative memory of a non-semantic kind.

A forceful recent recommendation of contrastivism can be found in Ali Boyle's paper, 'Remembering events and representing time'. There, Boyle suggests that the term 'episodic memory' was introduced to 'mark an exhaustive division in declarative memory' (2021: 2511). In line with this, she urges us to take the term 'to pick out the type of declarative memory that is not semantic' since 'marking this fundamental division in declarative memory is the central theoretical work the episodic/semantic distinction is supposed to do' (2513). As Boyle notes, David Rubin and Sharda Umanath adopt a similar stance towards what they call 'event memory' and which they take to be 'the fundamental natural kind that is an [sic] opposition to knowledge (i.e., semantic memory)' (2015: 2).

Several questions arise about this picture.

First, insofar as episodic memory is intended to 'mark an exhaustive division in declarative memory', we need to know what *declarative* or *explicit* memory is. This is no trivial question. Explicit or declarative memory might mean a form of memory which a person can *make explicit* or *declare* via a verbal statement. Such a characterization obviously cannot be accepted by anyone wishing to allow for the possibility of episodic memory in pre-linguistic infants and non-linguistic animals. Moreover, even theorists persuaded that episodic memory is unique to adult humans (e.g., Tulving and Markowitsch 1998) must justify according verbal reports so special a role—a role not standardly accorded to verbal reports in relation to other mental states, and one which would seem in tension with the fact that we often struggle to articulate our memories verbally. However, if we don't restrict 'making explicit' to linguistic performances, more needs saying as to which performances are allowed to count—especially if the forms of memory depicted on the left of Figure 1 (e.g., habits and skills) are to be excluded since these evidently show up in behavior.

Sometimes ‘explicit’ is understood in terms of consciousness. Few, however, would claim that we had a firm operational or theoretical grip on that notion (nor how exactly it applies to semantic memory). Another possibility is to understand explicit memory in terms of there being an internal representation of the memory’s content in the system, as opposed either to the content being derivable from what is represented, or—more substantively—to its being reflected in rules wired into the system, and in that sense procedural. However, it is far from clear that this notion captures all the cases typically placed in the implicit (non-declarative) category in Figure 1 (e.g., semantic priming).

A more promising approach understands explicit memory in terms of representations which are available to a wide range of cognitive operations, such as belief fixation, planning, reasoning, acting and reporting (cf. the concept of access consciousness articulated in Block 1995). Implicit memories would then be excluded insofar as the corresponding representations (if any) are only available to a narrow range of processes (e.g., perceptual or motor processes but not reasoning and reporting). Although promising, the proponent of this approach owes a more precise and principled account than the sketch just given. What constitutes a sufficiently wide range of processes? How do we handle the variability in such processes across species? And, what constitutes availability, exactly—actual access, potential access without further processing, or simply potential access even with further processing?

Let us bracket this first issue. A second, more immediate difficulty is whether we have sufficient grip on what *semantic* memory is, so as to define episodic memory in contrast to it, as *non-semantic* memory. One way to press this issue is to question whether semantic memory itself is a natural kind. Textbook examples of semantic memory involve factual knowledge such as the knowledge that Paris is the capital of France, or that Liz Truss was (briefly) UK Prime Minister

(cf. Tulving 1972: 387). However, as Brown (ms) points out, plausibly many different kinds of memory have some claim to being semantic, either in being to some degree abstract, or involving a discursive representational format. Yet these various forms of memory lack any clear unity. In addition to standard textbook examples, consider: cognitive environmental maps, models of system dynamics in model-based reinforcement learning models, tacit grammatical knowledge, or the representations of what Susan Carey calls ‘core cognition’, and which she characterizes as a ‘type of conceptual structure ... that differs systematically from both sensory/perceptual representational systems and theoretical conceptual knowledge’ in being richly conceptual yet created by innate perceptual analyzers, domain specific, and iconic (2009: 10). These forms of memory do not obviously form a single natural kind or even genus. In turn, this casts doubt on the idea that explicit memory divides into *two* exhaustive kinds. Instead, it suggests a picture on which explicit memory comes in a variety of different forms, with various cross-cutting similarities and differences.

In addition to these memories, we should consider memories of objects, people, and places (e.g., my first bike, my grandmother, London in the 90s) – on which see Debus (2007) and Openshaw (2022). And, also, general (i.e., merged, summary or prototype) event memories (e.g., visiting my grandparents as a child, reading stories to my daughter when she was little). Again, it is not obvious why we should feel forced to count these either as semantic or episodic, as opposed to distinct but related forms of explicit memory.² This final point connects to an issue highlighted in recent work by Andonovski (2020) and Aronowitz (forthcoming) namely that episodic

² Compare Neisser (1981) on ‘repisodic memory’. It is also not obvious how to place other forms of memory within the standard taxonomy, e.g., prospective memory, or short-term iconic, fragile visual and working memory. See further footnote 17 on observer memories.

memories are continually being transformed into *more* abstract, *more* ‘semantic’ memories via a suite of semanticization/schematization processes thought to correspond, at least roughly, to a transfer of encoding from hippocampal to cortical structures.

The key upshot is that we should be sceptical that episodic and semantic memory constitute two exhaustive natural kinds. On the face of it, ‘explicit’ memory comprises multiple distinct kinds of memory deriving from and/or contrasting with the prototypically episodic, with no obvious bipartite unity.

Where does this leave contrastivism? A helpful analogy here is with talk of the perception/cognition distinction. When people introduce such a distinction, presumably they do not intend an exhaustive division of the mind into two natural kinds, with the perceptual being understood as the non-cognitive, or vice-versa. For one, someone interested in the perception/cognition divide might well happily recognize affective or motor systems which fall into neither category. For another, introducing such a distinction does not presuppose it is a distinction between two natural kinds. Someone might, for instance, regard cognition as a ragbag of different kinds.³ Instead, one plausible understanding is that they take perception to be an especially basic form of mind from which certain other forms derive (e.g., episodic memory, perceptual belief, etc.) and which can be fruitfully contrasted with other mental forms (e.g., abstract factual knowledge, propositional desire, intentions, etc.).

Similarly, when we introduce episodic memory, we need not think of it as marking an exhaustive contrast with a singular contrasting kind, viz. ‘semantic memory’ but instead as

³ Compare Firestone and Scholl (2016: 1) who contrast perception with ‘higher-level cognition ... states such as beliefs, desires, emotions, motivations, intentions, and linguistic representations’.

highlighting a particularly basic form of memory from and with which certain other forms can be derived and contrasted. Such a proposal fits naturally with Brown's skepticism that semantic memory is a natural kind, and likewise with the idea of schematization processes producing 'a variety of intermediary forms of varying generality' (Andonovski 2020: 342) or 'range of contents differing in degrees of episodicity' (Aronowitz, forthcoming).

This proposal of course behooves us to provide some *direct* characterization of episodic memory. What is this supposedly basic form of memory? Famously, Tulving offers a direct characterization of episodic memory, as memory of 'personally experienced unique episodes' (1972: 387) or 'memory for personal experiences and their temporal relations' (401-2) – a characterization he embellishes in subsequent work, invoking notions such as auto-noetic consciousness and mental time-travel (e.g., Tulving 2001, Wheeler, Stuss and Tulving 1997). Tulving's original conception echoes Reid's pioneering discussion where he speaks of memory as involving the 'renewal of a former acquaintance with the thing remembered' – his example being his memory of the transit of Venus in 1769, which he says he 'must therefore have perceived ... at the time it happened' (1785/2002: III.1, 253-5).⁴

⁴ For discussion of Reid's view, see Copenhaver 2006. On Copenhaver's interpretation, there are important differences between Reid's view and that here defended. First, whilst Reid takes the objects of memory to be events, he denies that these events are experiences, insisting that they are (at least in relevant cases) worldly not mental events. The view here claims that episodic memory has *both* perceptual experiences and their worldly objects as its objects: Reid remembers the transit of Venus by remembering perceiving it. Second, at least on Copenhaver's 'constitutive' interpretation, Reid takes a belief that the remembered event was a past occurrence to be an essential ingredient of memory. No such belief—nor even any tensed content—forms part of the present account.

Here, I propose that we adopt a kindred answer, on which episodic memory is memory *for personal experiences*. (For reasons to be discussed in §3, I omit Tulving's 'and their temporal relations' (1972: 402).) To unpack this idea, let us focus on Reid's sighting of the transit of Venus. Here, we have a perception of an event which takes place in 1769. Writing sixteen years later, Reid does not perceive the transit again. Instead, he has, in some sense, retained his past perception in memory. On the present proposal, this is understood in terms of his possession of a standing capacity to *represent* that particular perception together with its object (i.e., Venus' transit). The past perception and its object thus come to be before Reid's mind in virtue of a standing capacity which his 1769 perception has given rise to, and which can manifest in a specific episode of recall. Importantly, the transit comes to be before Reid's mind in 1785 in a quite different manner to the way it was before his mind in 1769. In 1769, it was the object of a present perception; in 1785 it is before his mind as the object of a represented past perception. Generalizing, episodic memory is the capacity to *representationally* return past experiential episodes to mind.⁵

On this view, episodic memory contrasts semantic memory with respect to its contents or objects. Certainly, we can have semantic memories of past events and experiences. But with semantic memory the relevant memory contents are *facts* or *propositions* about our pasts, with past occurrences at best figuring as constituents of these. The contents of episodic memory are not facts or propositions but *events* or *occurrences*.

Various concerns beset such a picture. Let me briefly mention three. The first is that the picture imposes sophisticated metacognitive requirements on episodic memory. However, although the present proposal claims that episodic memory involves the representation of one's

⁵ For a now classic elaboration of this picture, see Martin 2001. See also Martin 2015 and 2019.

prior perceptions, it does not claim that such representation is conceptual, requiring (e.g.) possession of the concept *perception*. Nor does it require any cognitive attitude, such as a belief that the recalled event occurred in one's past. Consequently, there is no obvious reason to think that the present picture is inconsistent with non-human animals who lack such concepts or attitudes having episodic memories. Compare how we might happily attribute perceptual object-representations to a non-human animal without requiring that they possess the concept *object*.

A second familiar concern is that the process of episodic recall involves a great deal of (re)construction and supplementation relative to impoverished traces. Many have suggested that this rules out thinking of episodic memory as genuinely renewing our former apprehension or acquaintance.⁶ In reply, a perceptual analogy is helpful. In vision, too, there is notorious underdetermination of what we see by the proximal retinal image. In solving this underdetermination problem, a critical role is played by inferential processes exploiting background knowledge (e.g., Bayesian inference exploiting learned and/or innate perceptual priors).⁷ This is certainly an impressive achievement. As Gregory famously puts it: 'We are given tiny distorted upside-down images in the eyes, and we see separate solid objects in surrounding space. From the patterns of stimulation on the retinas we perceive the world of objects ... this is

⁶ Schacter and Addis review relevant empirical work, arguing that memory errors 'provide critical evidence for the fundamental idea that memory is not a literal reproduction of the past, but rather is a constructive process in which bits and pieces of information from various sources are pulled together' (2007: 773). Such ideas trace back to Bartlett 1932. For philosophical discussion, see Michaelian 2012, 2016 and De Brigard 2014.

⁷ This at least is the classic view tracing back to von Helmholtz 1910/1962, and elaborated in (e.g.) Gregory 1966, Marr 1982, Rock 1983, and Knill and Richards 1996. For an alternative perspective, see Gibson 1979, reviewed in Rodgers 2021.

nothing short of a miracle.’ (1966: 7) Yet, however seemingly miraculous, few conclude that vision does not afford us a way of perceiving environmental particulars (though, see, e.g., Seth 2021). Instead, the relevant processes of supplementation and reconstruction based on stored information are taken to be part of what *allow* us to perceive our perceptual environments.⁸ It is not obvious why a similar response cannot be given to the constructivist challenge in the case of episodic memory, namely that we should think of the processes of (re)construction and supplementation involved in retrieval as what allow us to retain and renew acquaintance on the basis of severely impoverished traces.⁹

A final concern is pressed by Aronowitz (forthcoming) who argues that retained acquaintance is not the *kind* of thing that can be semanticized. The precise issue here is delicate. Aronowitz presses it in light of two different (and neither uncontroversial) ways of conceptualizing semanticization, viz., Buzsáki and Moser’s (2003) navigational theory on which semanticization reflects computations analogous to those involved in shifting from egocentric to allocentric encodings of our spatial environments; and McClelland et al.’s (1995) complementary learning

⁸ Some argue that whilst constructivist models of perception are compatible with the perception of environmental particulars, they are incompatible with relational or naïve realist accounts of perception. For a reply on behalf of the naïve realist, see French and Phillips 2023, also Campbell 2002 and 2011. A related argument might be made against the present view of episodic memory; I suggest that an analogous reply is available.

⁹ Of course, the perceptual analogy only goes so far and much more needs saying to provide a full defense of the present picture of episodic memory. For instance, as Matthew Soteriou pointed out to me, a significant difference between perception and memory is that in perception the question of which particular is being perceived is partly a matter of which particular is presently triggering and sustaining one’s perceptual state. In contrast, memory is a standing capacity which can be exercised in the absence of its object. As a result, one might argue that sensory memory cannot alone secure reference to particular past episodes without the help of cognition.

systems approach, on which semanticization involves extracting information from richly detailed spatiotemporal representations through a process of repeated offline ‘replay’ to produce abstract, general representations. On neither theory is it entirely clear what constraint is imposed by recognizing that episodic contents must be amenable to semanticization. Nor crucially is it clear that we should accept the implicit assumption in play that the categories and (presumably, representational) kinds of such theories neatly map onto the categories and kinds of personal level psychology (cf. the discussion of perceptual kinds in Phillips 2018, French and Phillips 2023, and Campbell 2011).

Again, however, it is worth noting that an analogous ‘interface problem’ arises in the case of perception. Perception seemingly effortlessly revises, creates and updates our beliefs. This undoubtedly poses an explanatory challenge. But it is far from obvious that it provides decisive reason to think that perception and cognition must exploit a common format. To the contrary, many theorists insist that it is precisely differences in format which help characterize the distinction between perception and cognition. For instance, Burge (2022) holds that natural, and so human, perceptual representation is constitutively iconic and non-propositional (e.g., 2022: 331), and Block (2023) makes the stronger claim that perception quite generally is constitutively iconic and non-propositional (2023: Chpts 4-5). And whilst it is true that some theorists do argue in favour of architectural views and against format-based accounts on the grounds that the best explanation of the ease with which perception updates belief is that it outputs representations in the same discursive representational format as thought (e.g., Mandelbaum 2018, Quilty-Dunn 2022: 809), these theorists face their own ‘interface problem’. This is because such theorists recognize a plurality of representational formats *within* perception. They must then explain how fast inferential

processing can occur *within* perception despite such differences of format, in turn raising the question of why any such explanation cannot explain transitions between perception and cognition.

These considerations do not directly answer Aronowitz's challenge. But to the extent that one is sanguine that the analogous challenge can be met in relation to perception, they suggest that we should not be over hasty in concluding that semanticization is inconsistent with the picture of episodic memory here espoused.

Relatedly, and in line with what Andonovski calls the 'transitional gradation challenge' (2020: §4.2), one might press that the gradual nature of the transitions between forms of memory threatens a conception of episodic memory as retained acquaintance. But the existence of a continuum of hybrid cases involving purely episodic as well as more general elements (or similarly memories which summarize two, three, four... episodic memories) does not call into question the existence nor explanatory priority of purely episodic memories. In the same way, theorists like Block and Burge can, and readily do, acknowledge that there exist a range of non-perceptual states which are immediately derived from and exploit or incorporate iconic and perceptual elements (see, e.g., Block 2022: 215 and Burge 2023: 332 on perceptual beliefs). This is consistent with the existence of purely iconic states.

With these preliminary remarks behind us, I now turn to the core questions of the paper: To what extents, if any, is episodic memory spatial and temporal?

Is episodic memory constitutively spatial?

To address the central question of this section, I take as my stalking horse the view proposed by David Rubin and Sharda Umanath in an important theoretical paper from 2015.¹⁰ There, Rubin and Umanath distinguish between *event memory* and *semantic memory*. On their account, the key feature distinguishing event memories from semantic memories is their spatial content. Specifically, they tell us that ‘an event memory is a mentally constructed scene’, where a scene is ‘an organized spatial layout that locates the person remembering relative to the rest of the scene’ (Rubin 2022: 467-8). For Rubin and Umanath, episodic memories are a special subclass of event memories marked out by further features in which the represented events are unique, about the self, relived, and voluntarily constructed. However, being a subclass of events memories, episodic memories must also in their view have a distinctive spatial content.

Rubin and Umanath’s view has been influential in philosophy. In particular, Boyle (2021) suggests that we endorse their view as a view of episodic memory in general, in other words, that we identify Rubin and Umanath’s event memories with episodic memory—event memories being (as discussed above) the fundamental natural kind which contrasts semantic memory. Rubin and Umanath’s view also has various Kantian precedents. Consider, for instance, Russell and Hanna’s *Kantian Minimalism* according to which ‘just as experience must involve an experiencer’s spatial perspective on objects and events, so too must re-experience’ (2012: 33).¹¹

¹⁰ Rubin and Umanath are far from alone amongst scientists in insisting on a tight connection between space and episodic memory. For instance, Moser et al. aver that ‘space is a central element of all episodic ... memories’ (2015: 3).

¹¹ Russell and Hanna make the same claim about time, taking experience to be necessarily spatiotemporal, and therefore also in their view episodic memory conceived as ‘re-experience’.

What argument do Rubin and Umanath give in favour of their picture? Here is one key passage:

An event memory must have spatial organization; without it, the memory ... will be judged as knowledge.... One would judge one's recall to be a memory of an event only if it was experienced as the recall of a [spatial] scene. (2015: 4)

Why think that it is true that without a spatial scene we would judge an event memory instead to be a semantic memory? A clue comes in a second passage, where Rubin and Umanath offer the following consideration.

Because a scene cannot be imagined ... without an assumed viewpoint, ... the self enters as a locus in space and time (...) from which the scene is remembered. ... This egocentric perspective from a specific spatial location is what distinguishes event memory from knowledge in phenomenological terms... (2015: 1)

How should we reconstruct this argument? The basic idea appears to be that there is a structural, phenomenological difference between event (or episodic) memory and knowledge (or semantic memory). This structural difference is held to essentially involve the presence of an egocentric perspective within the content of episodic memory. This perspective is then claimed to be a spatial viewpoint on the recalled scene. In turn, this warrants the conclusion that, to be

distinguished from semantic memory, episodic memory must involve a spatial viewpoint on a spatial scene.

The most obvious concern with this argument is that, whilst it seems right to hold that a *spatial scene* cannot be episodically recalled except from a spatial viewpoint (and thus that episodic memories of *spatial scenes* must involve a spatial viewpoint), no reason is given for thinking that episodic memories *in general* must involve a spatial viewpoint. To assume that all episodic memories are of spatial scenes would simply beg the question.¹²

Let us then grant that episodic memory critically involves a represented perspective—as we’ll see below in discussing the Dependency Thesis, we can think of this perspective as the *experiential* perspective represented in memory. What we need to ask here is: Must this represented perspective be a *spatial* perspective which the recalled contents are represented as related to, and so as spatial in turn? Doubts on this score are most easily appreciated by consideration of putative counterexamples.

Discussions of episodic memory are often visuocentric (witness the use of the term ‘viewpoint’ as a synonym for ‘perspective’ in the second passage quoted above). But we can of course enjoy non-visual memories. For instance, you might smell a powerful aroma and then later recall having done so. Having once smelled ripe durian fruit, you might never forget its pungent odor which one writer describes as ‘turpentine and onions, garnished with a gym sock’ (Sterling

¹² Two further puzzles arise concerning the argument. The first concerns the assumption that the assumed viewpoint will inevitably be *the self*. The second concerns the apparently differing attitudes to space and time. For whilst the assumed viewpoint is initially introduced as ‘a locus in space and time,’ it is only the spatial location of the viewpoint which is subsequently drawn on to distinguish event from semantic memory.

2003: 102). Likewise, you might hear a distinctive tune and long recall it thereafter. Perhaps you can recall once hearing a thrush nightingale sing.

Such memories may involve rich spatial scene construction—perhaps you recall yourself smelling the fruit in the midst of a bustling Thai market, or hearing the bird in the thick of a Romanian forest. But it is far from obvious they must. Simply to recall that particular experience of the pungent odor, or that particular hearing of the bird’s resonant high pitched *piuu, piuu*, does not obviously require representing oneself as occupying any particular spatial location, nor spatially relating any features to such a location. This is not because olfaction or audition in general lack spatial content.¹³ It is because olfactory and auditory memories may sometimes fail to specify any such content. Mohan Matthen contends: ‘Auditory memory is hardly ever spatial: usually when you recall a tune, you don’t hear it as coming from anywhere.’ (2010: 14) I make no claim about frequency, which may well vary by individual, but Matthen is plausibly right about the simple possibility of such memories.

Examples of non-spatial memories in non-visual senses may not convince everyone. One might suspect, for instance, that they simply involve extremely generic spatial content (the tune coming from ‘somewhere’ or ‘nearabouts’ etc.). Or one might be concerned that when fully deprived of spatial content, such memories become general event memories as opposed to episodic memories proper. Fortunately, we can set aside these concerns, since there is a much clearer case

¹³ Reid notoriously makes this claim about olfaction, suggesting: ‘It is evidently ridiculous, to ascribe to [a smell or odour] figure, colour, extension, or any other quality of bodies. [One] cannot give it a place, any more than [one] can give a place to melancholy or joy’ (1764/1997, I.i.2). For criticism of this tradition, see Richardson (2013) who argues that we do perceive odours as external to our bodies, specifically as in the vicinity of our noses and as brought into our noses by sniffing. For discussion of the spatial content of audition, see NuDDS 2009.

where spatial scene construction can be absent from episodic memory, namely memories of our mental actions, and specifically our thoughts.

As Michael Hasselmo describes at the start of his wonderful book, *How We Remember*, what he calls ‘episodic trajectories are not necessarily limited to the dimensions of physical time and space ... I also remember my thoughts’ (2012: 7). In remembering, in Browning’s phrase, being ‘stung by the splendor of a sudden thought,’ one need not remember any spatial content. You can simply remember having the thought. It makes perfect sense to say, ‘I have no memory at all of where or when it was, of what happened before or after etc., but I vividly remember thinking ...’. To allow for the possibility of such memories, we must deny that all episodic memories constitutively have spatial content. In consequence, Rubin and Umanath’s claim that scene content distinguishes episodic from semantic memory must be rejected.¹⁴

I do, however, think that an important idea in the vicinity of Rubin and Umanath’s is correct. This is the idea that memory is a *second-level* phenomenon, in that it involves the representation of a prior experience of yours.¹⁵ Thus, at the first level we have some form of experience: seeing a scene, hearing a tune, thinking a thought. Then, at the second level we

¹⁴ A possible line of objection is that all memories include some awareness of one’s body, and so even in remembering a thought we necessarily remember it in the context of some background of bodily sensation. Specifically, Marcel Kinsbourne argues that a representation of the self is essential to episodic memory and claims that it is bodily awareness which ‘puts the stamp of personal experience on the scene’ (1995: 218). What is unclear, however, is why we should think *bodily* awareness either necessary or sufficient to secure the link between remembered experience and the self.

¹⁵ For detailed discussion of two-level accounts of experience more generally, see Martin 2019.

represent not merely the scene, tune or thought, but the seeing, hearing or thinking of the thought.¹⁶ This idea is sometimes called the Dependency Thesis. According to it, to paraphrase Martin (2001), to episodically remember an event is to remember previously perceptually experiencing that event or being the conscious agent of it.¹⁷

The Dependency Thesis helps us see what is right and wrong about Rubin and Umanath's argument, according to which episodic memory essentially involves a spatial viewpoint on a scene.

¹⁶ Note that where the first-level phenomenon involves acquaintance, we can think of memory as renewing such acquaintance. However, no commitment is made here to the idea that *all* episodic memory involves renewed acquaintance. Indeed, recognizing that we can episodically remember our thoughts puts pressure on that idea to the extent that one might want to resist the idea that thought involved acquaintance.

¹⁷ As formulated, Dependency claims that to remember is to remember *one's own* perceptual experience of an event etc. This raises the question of what to say about so-called *observer* as opposed to *field* memories: memories in which we recall a past episode from a perspective distinct from that which we experienced it, perhaps even looking at ourselves identified as such (see Nigro and Neisser 1983). One option here is to think of the perspectives taken-up in these memories as genuinely our own viewpoints on the grounds that our perceptions contain both egocentric and allocentric spatial information (for a rich discussion, see McCarroll 2018). A more straightforward reply is to think of such memories as immediate cousins of episodic memories, though not strictly episodic memories proper. One reason to insist on a close connection is that, like field memories, they arguably secure a link back to our own experience insofar as the content of any experience represented in an observer memory must be properly inherited from an earlier experience of our own. This allows for transformations to new perspectives in observer memories, whilst preserving what Martin calls the *Previous Awareness Condition*, the idea that 'one can remember an event only where one previously witnessed it or was the conscious agent of it' (2001: 261). Note further that the 'fact that certain *elements* of an experience depend on some present reconstruction [e.g., the transformation to a novel perspective] does not imply that the whole experience could not possibly count as a memory at all' (Debus 2007: 197, and her discussion in §5 more generally).

What is right is that a distinctive feature of episodic memory is that it embeds a ‘viewpoint’: the subjective perspective of an experience of the recalled content. But what is wrong is the idea that this viewpoint need necessarily bring with it any spatial content. It will only do so if the first-level viewpoint must necessarily be represented as a spatial viewpoint. But our cases of non-visual memory, and above all memories of thoughts, suggest that this need not be the case. Arguably, the idea that episodic memory is essentially spatial thus reflects a recognition of Dependency combined with an overly narrow a focus on certain kinds of visual memory where an essential connection with space is more plausible. In general, however, episodic memory is not constitutively spatial.¹⁸

Dependency also allows us to see what is right and wrong about the common idea that the phenomenology of memory is one of perceiving again. For instance, Fabrice Teroni suggests that the ‘phenomenology distinctive of memory’ involves ‘it’s being for the subject as if she perceived particular events again’ (2017: 27). Taken at face value, Teroni’s claim here is false. Episodic recall is not a form of hallucination. Nonetheless, his claim rightly reflects the internal connection between the phenomenology of episodic recall and perception, one captured by the dependency of the former on the latter. What is right from the perspective of the Dependency Thesis is that there is an internal connection between the phenomenology of perception and the phenomenology of memory—to remember is to remember perceiving (or acting). What is wrong is to suggest that they have the very same structure. They do not. Perception involves a direct acquaintance with the

¹⁸ This said, it is certainly worth exploring whether some extended or abstract notion of space (as in: pitch or color space) might offer a way of recovering a version of Rubin and Umanath’s claim that episodic memory is constitutively spatial.

environment. Memory involves the representation of such acquaintance and thereby the experienced environment.

Is episodic memory constitutively temporal?

Even if episodic memory is not constitutively spatial, one might think it far more obvious that it has a constitutive connection to time. Here, however, it is important to distinguish a number of quite different connections which one might posit between episodic memory and time. With these distinctions in mind, I now argue, contrary to various authors, that episodic memory has only a minimal constitutive connection to time. I consider three putative connections. First, the idea that episodic memories necessarily represent *when* their events occurred. Second, the idea that episodic memories necessarily have *tensed* contents, representing their contents *as past*. Third, the idea that episodic memories necessarily have *temporal contents*, for instance, representing succession, duration and change.

Remembering when

A first way in which episodic memory might be thought constitutively temporal is if it necessarily represented *when* its events occurred, either in terms of absolute location or distance from the present moment. However, despite continuing claims to the contrary¹⁹, it is now a familiar

¹⁹ For instance, Smith and Mizumori: ‘episodic memories, by definition, include information about the time and place where the episode occurred’ (2006: 716). Cf. Clayton and Dickinson (1998) on episodic-like memory as what–where when memory.

point that it is ‘possible, though rare, for one to re-experience an event memorially but have no robust knowledge of how long ago it happened’ (Russell and Hanna 2012: 32).²⁰ Indeed, a case can be made for the stronger view on which our knowledge of *when* a recalled event occurred is largely, if not exclusively, a matter of non-temporal features and background knowledge.²¹ Here we might compare memory to a photograph collection in which the photos lack labels, date stamps, or chronological organization, leaving one to figure out from various clues (e.g., the type and fading of the photograph, background knowledge about the fashions and hairstyles people are sporting, etc.) when each photo was taken. I return to the question of the association between episodic memory and temporal organization in the final section. For now, I simply accept the minimal point that some episodic memories do not encode substantial information about when the remembered event occurred.

Remembering as past

Even if memories do not always encode *when* a remembered event occurred, one might nonetheless think that memories at least represent events *as past*, and perhaps locate when they occurred in that very minimal sense (i.e., before *now*, the time of recall). Indeed, the claim that

²⁰ Boyle puts the point more strongly, holding that there are ‘a great many cases in which we have episodic memories for events we are unable to temporally locate’ (2021: 2515).

²¹ See, e.g., Rubin and Umanath: ‘The time of an event need not be known, either in absolute terms or relative to other events; deciding on when an event occurred is a separate set of processes from recalling other properties of the event’ (2015: 2). Also, Friedman (1993): ‘time information is stored ... in our more general body of knowledge about time patterns’ (see also his 2004; Brewer 1986, 1996; Rubin & Baddeley 1989; St. Jacques et al. 2008). For critical discussion, see Brown and Chater 2001: 102ff.

whereas perception represents events *as present*, episodic memory represents events *as past* is ubiquitous.²² Here, however, and drawing on Martin's (2001) discussion of the Dependency Thesis, I want to suggest a more minimal picture which I suggest captures the intuitive data and yet denies that episodic memories themselves have past tensed content. At the very least, I take this more minimal picture to show that the claim that memories represent events in a tensed fashion (i.e., as past) is not simply something that can be taken for granted without argument.

According to the Dependency Thesis, episodic memory represents *particular* experiences. Now, to the extent that we are in position to know what experiences we are undergoing when we are undergoing them, when we remember a particular experience, we are in a position to know (a) that we are not *then* undergoing it, and (b) that it is nonetheless the representation of a *particular* experience.²³ Thus, we can know that our memory is not of a present experience, but of some other

²² A small sampling from philosophical discussions: 'In the memory mode, the content is presented as true with respect to a past perceptual situation, hence the scene represented is felt as past' (Recanati 2007: 141-2); 'Episodic memories ... represent themselves as having a certain causal history, namely ... as coming from past perceptions of objective facts' (Fernández 2016: 636-7; cf. Searle 1983); 'memory-experience presents itself as about the past' (Matthen 2010: 8), 'Episodic memory is, in and of itself, an experience of an image as in the past.' (ibid.: 11); 'We can think of episodic memory as an explicit representation of the past. Its functional value is rooted in its representation of a past experience itself, that is, a representation of the past *as past*.' (Droege 2013: 183). Brown and Chater: 'episodic remembering seems to require the ability to represent an event as having happened at a particular time in the past' (2001: 77, citing McCormack and Hoerl 1999). Finally, Russell: 'what we remember ... appears as past and not as present' (1912/2001: 26).

²³ In paradigm cases of episodic recollection, we know that we are recalling a particular episode as opposed to imaging an event type. But it is by no means obvious that this is always the case. Certainly, sometimes we may confuse genuine memory for mere imagination, and so fail to appreciate the particularity of the representation. However, such cases alone do not suffice to show that we are not always *in a position to know* that we are recalling not imagining.

particular experience. This leaves open two possibilities: that the recalled experience is past or future. However, the represented experience is a *particular* experience, we can be sure, given the basic causal structure of the universe we live in, that it must be located in our pasts. For only then could it have left its causal mark on us in such a way that we could now be reacquainted with *that* event in particular. Our universe does not admit of precognition.²⁴ The upshot is that we can know that episodic memory links us to the past without any need to postulate tensed content.²⁵ Put another way, the contents of our memories in and of themselves do not determine that they are not ‘memories’ of future particular experiences. This is ruled out instead by very general background physical facts about our world.

Another analogy with photography may be helpful here (though as with all analogies has its limits). Imagine taking an old photograph back to the place where it was taken, perhaps with the aim of taking a second photograph as in Figure 2. Holding up the original photograph as the photographer is doing here, the photographer may be in a position to know that the photograph depicts events which occurred in the past. But to explain this, we need not attribute tensed contents to photographs. Instead, the photographer can simply reflect on the contrast between what he can

²⁴ A link to our *own* past, as opposed to someone else’s, may also be secured in like manner. On this view, episodic memories would not represent past experiences as *ours*. Instead, our recognition that such memories must be from our pasts would be grounded in an implicit appreciation of the fact that a link to a particular past experience could not be secured by a chain or trace which took us outside of our own mind. Thus, just as our universe contains no precognition, it also admits no telepathic transmission.

²⁵ For further discussion, see Martin 2001. Of course, such thoughts are not articulated by most people in their ordinary thinking about memory; rather they make explicit what is implicit in and justifies our ordinary thinking. Note that generic event memories (e.g., reading bedtime stories to one’s child when young etc.) can still be understood as located in our pasts, insofar as they are not purely general, but rather genericizations of particular events.

currently see and what is depicted in the photograph, a contrast which suffices to show that the photograph does not depict things as they are now. He can then further reflect that the way our world works precludes taking photographs of the future, for photography is a causal and so forwards-only process, which thus can only record particular past occurrences and scenes. Thus, the photograph depicts the past. There is only re- not pre-photography.²⁶

The view here is not intended to impose substantive intellectual requirements on episodic memory itself, and so again has no implications for the distribution of episodic memory across humans and non-human animals. It does though imply that appreciating that our episodic memories relate to our pasts (as opposed to our futures or to merely possible events) is a cognitive achievement which goes beyond simply having such memories. Just as the capture, use and collection of photographs is possible without any general understanding as to why photographs always depict the past, so too a creature need not have any capacity to make explicit the reasoning offered here in order to form, use and store episodic memories. One might object here that episodic memories have a distinctive phenomenology, an immediate ‘felt-as-past’ character, as it were. The view here denies this. What is critical to episodic memory’s connection to the past is the particularity of its content and not its being past tensed.

²⁶ Note here the contrast with paintings which can depict future events, but cannot, independent of the intentions of their painter, depict particular events (see here Martin 2001: 276). As with remembering, note that it is a non-trivial achievement to appreciate that a print is indeed a photograph (as opposed, e.g., to a print of an entirely AI-generated image) and so depicts a particular.



Figure 2. 'Looking into the past - take 2'. © Nomad Tales. Attribution-ShareAlike 2.0 Generic (CC BY-SA 2.0). Example of rephotography. Original photograph of flooding on the High Street, Maitland, NSW taken in 1955, second photograph of same high street, taken 2010.

Remembering and internal temporal content

Thus far, our discussion has been largely negative. However, I now want to explore a more positive connection between episodic memory and time, a connection which again relates to the Dependency Thesis discussed above.

Often the objects of memory are extended episodes: a live performance, a wedding speech, a dramatic fall. In remembering them, we often represent their temporal features such as succession, duration or change. However, we should allow for the possibility of snapshot

memories.²⁷ Thus, in general, we should not insist that memories must have such temporal features amongst their contents. On the other hand, by Dependency, in the case of perceptual memories, when we remember a past event, such as a performance, we remember previously perceptually experiencing that event. This means that the contents of such perceptual memories do always involve a minimal temporal aspect. This is because we not only remember the performance which occurred and our hearing and seeing of it, but these as temporally related to one another.

Elsewhere, I have defended a particular view about the relationship between the timing of perceptual experience and the timing of its objects.²⁸ According to this view, temporal features of experience are *inherited* from their objects. More precisely: for any temporal property apparently presented in perceptual experience, experience itself has that same temporal property. In particular, the apparent temporal location and duration of an event determines the temporal location and duration of our experience of said event. Inheritance articulates the idea that part of what it is like to perceive the world from a perceiver's own perspective is to be temporally yoked to the world. Our stream of consciousness is manifestly concurrently shaped by the events we consciously perceive.

By Dependency, perceptual memories involve representing being so temporally yoked to the world. We thereby represent our stream of consciousness being determined in its temporal location and duration (if any) by the recalled event. To that extent, episodic memory involves the

²⁷ Compare Tulving, who describes his General Abstract Processing System framework as offering a “snapshot view” of episodic memory [focusing] on the conditions that bring about a slice of experience frozen in time which we identify as “remembering”, further proposing that episodic memory ‘produces many snapshots whose orderly succession can create the mnemonic illusion of the flow of past time’ (1984: 231).

²⁸ See Phillips 2009, 2010, 2014a, reviewed in Phillips 2014b. For closely related ideas, see Soteriou 2010 and 2011.

representation of a temporal structure: an experience and its object, occurring (and perhaps unfolding) together in time. Recall Rubin and Umanath's argument that episodic memory essentially involves a spatial viewpoint on a scene. I rejected this contention partly on the ground that we can have non-spatial (e.g., auditory and olfactory) memories. However, we can now see that there is a sense in which all perceptual memories do essentially involve a temporal 'viewpoint': the subjective temporal perspective of our experience of the recalled episode. There is then a minimal respect in which episodic memory represents when an event occurs: it represents the event perceived as occurring *contemporaneously* with our perceiving of it (and indeed as determining the temporal location of that perceiving).²⁹

These claims relate specifically to perceptual memory. As against Rubin and Umanath's claim that episodic memory is constitutively spatial, I objected that we can also remember our thoughts. The claims just made do not extend to the case of recalled thought. For no analogue of inheritance applies to thinking; the temporal locations and durations of our thoughts are not inherited from their objects—you can ruminate for hours on a momentary incident, or for just a moment about an epoch. On the other hand, in the case of conscious thought it is far from obvious that we can genuinely make sense of snapshot memories. To remember thinking, in a genuinely

²⁹ The discussion here is indebted to Soteriou's (2018) rich defence of the idea that episodic memory constitutes a form of 'mental time travel'. Soteriou argues that episodic memory provides a 'way of representing entities as temporally present' (2018: 308) which is distinct from past tensed thought. Specifically, he argues that in representing a perceptual perspective on a past event (as Dependency holds one does in episodically remembering), one represents a temporal perspective whose temporal location is determined by the temporal location of the past event itself. As a result, one represents a perspective distinct from one's actual present perspective to which the past event is present. I take the picture defended here to be close to Soteriou's. However, it is neutral on whether there is strictly any tensed representation in perception or memory (i.e., representation of events as temporally present).

episodic manner (as opposed to simply that one had a certain thought), might seem necessarily to involve recalling some (at least briefly) extended episode.³⁰ If this is right, then a more general claim about episodic memory can still be made, namely that episodic memory constitutively has some internal temporal content: minimally, duration in the case of recalled thought, and simultaneity in the case of recalled perception.

Space, time and the organization and encoding of episodic memory

In this final section, I briefly consider whether what is known about the encoding and organization of *human and mammalian* episodic memory motivates a stronger link between memory and spatiotemporal representation than the minimal connection so far acknowledged.

In approaching this question, we must center a feature of memory hitherto neglected, namely storage and retrieval. Memory is not simply a depository where event-representations are stored without any particular structure or system: a giant pile of photographs tossed into a mental junk drawer. Rather, as Aronowitz powerfully argues, a ‘core function of any memory system is to support accurate and relevant retrieval’ (2019: 483). And if memories are to be retrievable in a timely and contextually appropriate manner, they must be *organized*.

As Aronowitz (2019) discusses, there are important questions here as to how such retrieval efficiencies are achieved. For example, do our memory systems index an unorganized store, or organize memories into simplified models, or both? But in either case, it will be necessary to use general, abstract ‘contextual’ features in indexing or modelling. Moreover, just as people typically

³⁰ For an argument that conscious thinking necessarily involves mental events with duration, see Soteriou 2009.

organize their photographs chronologically, it is natural to ask whether space and time provide special, perhaps even naturally necessary, organizational dimensions in relation to episodic memory. If so, whilst particular episodic memories might lack spatiotemporal content, in general, the association of episodic memories with information about spatiotemporal context would be critical to the proper functioning of the episodic memory system. To take up our analogy with photographs once more, memory may be like a chronologically organized photograph collection, in which, occasional stray photographs aside, all collected photographs are associated at least with a relative temporal position.

As discussed by Brown and Chater (2001, drawing on Anderson 1990), there are clear adaptive reasons to suppose that memories will be organized spatiotemporally. For suppose that retrieval is costly in terms of time and/or limited resources, then it will be important to ensure that what is retrieved is maximally relevant. Moreover, space and time are both externally and internally linked to relevance. In terms of external linkages, and all else equal, the relevance of information declines monotonically with distance from our current location. Arriving in Rome, we want to recall how the Romans do things, not the Greeks, still less the Egyptians. Similarly, for duration. In today's Rome, information about current customs and conditions is likely much more relevant, than information about those during the 1960s, let alone the height of the Republic.³¹ In terms of internal linkages, and again all else equal, it is plausible that having accessed a memory concerning some location or time, it is more likely that information concerning nearby times and

³¹ More precisely, and again all else equal, relevance declines monotonically with time since last *retrieval* (Anderson and Schooler 1991).

places will be relevant (cf. Aronowitz 2018 on temporally ordered retrieval, as in the familiar—but effective—routine of trying to find a lost item by asking when you last saw it).³²

These considerations only take us so far. They show that there is adaptive value in organizing memories spatiotemporally. But, as Brown and Chater concede (2001: 102), they do not show that memories will exclusively exhibit spatiotemporal organization. Indeed, similar adaptive arguments could be made in support of organization along many other dimensions. Suppose I am trying to recall a tune. Since tunes tend to continue with notes nearby in pitch, having recalled a note, then all else equal, information concerning continuations close by in pitch will be more relevant. Or, to anticipate an example below, suppose I encounter (or recall) someone who occupies a particular social standing with respect to me, a powerful friend, or a helpless stranger. All else equal, it will be most relevant to recall information concerning encounters with others located similarly along such social dimensions of power or affiliation. For I will want to recall how such people tend to act, what they tend to like or need etc. Now, of course, unlike a physical photograph album, nothing prevents memories being organized along multiple dimensions, either in the sense of being searchable using a range of different dimensions, or in the sense of exhibiting a pattern of activation dependencies along the lines discussed above. But once this very general point is recognized, it is unclear what would justify the assumption that time is ‘always a factor’ as Brown and Chater hold (2001: 102). Instead, the possibility arises not only that certain memories

³² Of course, all else is often not equal, and context is crucial. Thus, information about the Roman Republic might be a better guide to the politics of Washington D.C. today than information about the east coast of America even a thousand years after the fall of Rome. (Thanks to Simon Brown for the example.)

may be organized in non-spatiotemporal ways but that some memories may not be organized spatiotemporally at all.

One important reason to think that space and/or time are always a factor is that episodic memory systems have arguably evolved out of simpler systems apparently dedicated to spatial navigation (O'Keefe and Nadel 1978, Buszáki 2005) and time-dependent foraging (Gallistel 1990, Brown and Vousden 1998). Given this phylogeny, we might expect systems like ours to exhibit spatiotemporal organization, even if in principle other organizations are possible. Space and time might then be the basic or default mode of organization of human or mammalian memory.

According to a highly influential proposal supported by a wealth of studies on amnesic patients, hippocampal structures play a critical role in the coding of human episodic memories (e.g., Vargha-Khadem et al. 1997, Tulving and Markowitsch 1998, Aggleton and Brown 1999). Yet, as we know from rodent studies, hippocampus also plays a critical role in spatial navigation, being the site of so-called 'place cells': cells which fire at high frequency when an animal occupies a particular region of space and are thought to provide the basis for a rodent's 'cognitive map' of their spatial environment—a viewpoint independent representation (or better: overlapping set of representations) of the relationships between features and locations in the animal's environment (O'Keefe and Dostrovsky 1971, O'Keefe and Nadel 1978, Mizumori 2008).³³ So-called 'time cells' have also now been discovered in hippocampus and entorhinal cortex (Pastalkova et al. 2008,

³³ Several other types of spatially responsive cells are now recognized in hippocampus and entorhinal cortex, e.g., head-direction, boundary and grid cells. For review, see Hartley et al. 2014. Note that as discussed shortly below it should not be assumed that any of these cells *only* encode information about space. Nor should it be assumed that spatial navigational processing is in any sense limited to such brain regions. There is clear evidence that this is not the case, as discussed by Ekstrom and Ranganath (2018: 680-1).

MacDonald et al. 2011, Kraus 2015, Salz 2016, Umbach 2020). These are cells which fire at specific time points in a learned sequence even when the animal is stationary.

Together these findings raise the vexed question of how precisely such spatial and temporal mapping functions in rodents relate to human episodic memory. As Kathryn Jeffery argues: ‘If one assumes that there is a functional homology between rodents and humans with regard to the anatomy and mechanisms of episodic memory, then spatial and episodic functions need somehow to be unified.’ (2008: 69) Moreover, evidence of a broadly homologous basis for *spatial navigation* in humans (Ekstrom et al. 2003) raises the question directly of how episodic memory and navigational functions relate in humans given their apparently shared neuroanatomical basis.

There is now a great deal of evidence that non-spatiotemporal information is encoded by place and other hippocampal and entorhinal cortex cells. For instance, hippocampal cells have been found to respond strongly to many task-relevant stimuli such as odors, colours and visual-tactile cues (Eichenbaum et al. 1987, Igarashi et al. 2014, Anderson and Jeffery 2003, Young et al. 1994, reviewed in Eichenbaum et al. 1999). One way to understand this evidence is that hippocampal circuits³⁴ provide the basis of a spatiotemporal cognitive map which ‘is richly embellished by nonspatial information to form a representation of [spatiotemporal] context, used to (among other things) organize memories’ (Jeffery 2008: 65).³⁵ According to this proposal, episodic memories are organized by being “attached” to a map’ (ibid: 69), where this map is fundamentally spatiotemporal, even if other features are encoded as part of a richer spatiotemporal

³⁴ Henceforth, I omit reference to other connected regions such as entorhinal and parahippocampal cortex.

³⁵ Jeffery focuses only on spatial context, whereas for reasons given in the main text, I broaden this to spatiotemporal context. Note that, though I do not explore it here, it is possible to resist the move beyond space to time in the manner discussed below with respect to non-spatiotemporal dimensions.

context. On this view, then, whilst individual episodic memories themselves need not have spatiotemporal contents, a spatiotemporal framework forms the fundamental basis of episodic memory organization, subserving its critical retrieval functions.

However, an alternative account denies that hippocampal encoding is inextricably spatiotemporal. On this alternative, hippocampus maps relations quite generally, encoding relationships between myriad encountered sensory features across all relevant continuous dimensions. It is conceded that in everyday life, and perhaps especially in traditional experimental tasks (e.g., those involving maze exploration), that spatial information is typically such a reliable identifier of context ‘that its inclusion in context representations is largely automatic’ (Smith and Mizumori 2006: 721), leading to the appearance that space is privileged. However, strictly speaking, ‘spatial information is but one of the many kinds of information that serves the general context processing function of the hippocampus’ (ibid: 727). Thus, memory organization fundamentally involves an ‘interleaving of events and episodes into relational networks’ with space and time just being examples amongst equals of potential organizational relations (Eichenbaum and Cohen 2014: 764). From this perspective, ‘place cells’ (etc.) are misnamed since they encode many other kinds of contextual information depending on the task.

What considerations might be adduced in favour of this latter perspective? Aronov et al. (2017) trained stationary rats to release a joystick when a sound reached a fixed frequency range, decoupling pitch from temporal contingencies by randomly varying the speed of the frequency increase. Recordings of hippocampus and medial entorhinal cortex showed cells forming

‘frequency fields’, analogous to the ‘place fields’ famously associated with spatial navigation.³⁶ Aronov et al. take these result to show that ‘spatial representation is just one example of a more general mechanism for encoding continuous, task-relevant variables’ (2017: 7). Even more abstractly, Tavares et al. (2015; highlighted by Eichenbaum 2015) had human participants play a role-playing game in which they had to move to a new town and find work and housing. In the game, the characters with which participants interacted all occupied varying positions in an egocentrically defined ‘social space’ with axes corresponding to dimensions of power and affiliation (e.g., new boss, old friend). Tavares et al. found that hippocampal activity correlated with vector angle in this space, suggesting that hippocampal networks can map even highly abstract, culturally constructed spaces. Again, the authors construe this as evidence that neither space nor time provide a privileged organizational scheme for episodic memory; any abstract structure will do.

These considerations are not decisive. Evidence from such studies is consistent with the view that whilst place cells ‘might be interested in more than just space ... they are primarily interested in space’ (Jeffery 2008: 69). More generally, as Ekstrom and Ranganath argue, extant evidence does not rule out the view that space and time provide the ‘primary scaffold for defining contexts, and for organizing incoming information within a context representation’ with other dimensions being ‘incorporated into the scaffold’ as relevant (2018: 685). For instance, concerning Aronov et al.’s task, Ekstrom and Ranganath suggest that when the rats first entered the testing chamber, their hippocampi would have encoded information about the spatial and temporal structure of the chamber and task. Only later, after learning the task-specific pitch contingencies,

³⁶ Place fields are regions of space in which corresponding ‘place cells’ fire at high frequency. Frequency fields are thus pitch intervals in which corresponding cells fire at a high rate.

would this dimension of their experience have been added to their contextual representation (presumably without abolishing ongoing spatiotemporal coding). Another possibility is that information about non-spatial dimensions (frequency, social affiliation) becomes automatically associated with spatial information, with the result that spatial representations are activated in these tasks.³⁷

These issues are not yet settled and much remains unclear about the precise role and cognitive function of hippocampus (as well as other areas such as parahippocampal and entorhinal cortex). This said, the success of recent work (e.g., Whittington et al. 2020, Benna and Fusi 2021, Momennejad 2020) in predicting specific patterns of spatial and temporal neural responses simply by modelling the system as aimed at abstracting, generalizable structure from sensory episodes, would most naturally appear to support a view on which spatiotemporal representations are emergent features of a system which does not accord them any special privilege. On this more parsimonious view of the role of hippocampus as an extractor of abstract, generalizable structure, be it spatial or non-spatial, whilst of course we can expect our memories to exhibit spatiotemporal organization, the sense, if any, in which space and time are basic or default organizational dimensions of episodic encoding will simply be that these are—as a matter of contingent fact—primary organizing dimensions of our perceptual experience. We are spatiotemporal rememberers because we live in and perceive a spatiotemporal world.

³⁷ Consider here Walker et al. (2010) who provide evidence that cross-modal associations (such as between pitch and height) are present even in 3- to 4-month-old infants and so arguably reflect an innate aspect of perception. Thanks here to E.J. Green.

Conclusion

I have considered four issues: the nature of episodic memory, whether it is constitutively spatial, whether it is constitutively temporal, and whether space and time provide fundamental principles for organizing episodic memory. In the main, my answers have been negative. Episodic memory does not appear to be constitutively spatial, and its constitutive connection with time is far more minimal than most philosophers believe. Furthermore, whilst space and time do play a critical role in the organization of episodic memory, this role is neither obviously unique nor fundamental. On the other hand, I have defended a modest constitutive connection between episodic memory and time related to the temporal structure of its contents.³⁸

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³⁸ Thanks to all the participants at the Space, Time, and Memory conference for their comments and questions, and especially to Sara Aronowitz and Lynn Nadel for organizing such an excellent occasion. Special thanks to Ali Boyle for a very helpful conversation following my talk, and to Simon Brown, E.J. Green and Matthew Soteriou for hugely helpful written comments on an earlier draft which led to substantial improvements to the paper.

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