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Abstract: We propose an extension to Mahr & Csibra's (M&C's) theory. For successful episodic memory formation, potentially relevant aspects of a situation need to be identified and encoded *online* and retained for prospective interactions. To be maximally convincing, the communicator not only has to encode not just *any* contextual detail, but also has to track information *in relation to* social partners.

Mahr & Csibra (M&C) propose that the main function of episodic memory is to create reliable information packages through episodic reconstruction in order to convince others about the authenticity of a certain statement. Although the account offered does not make any predictions about the mechanisms involved, M&C argue that "the main achievements in episodic memory development occur as a consequence of the development of retrieval mechanisms" (sect. 4, para. 5). Consequently, they leave open the relationship between the characteristics of encoding and retrieval processes.

We propose that an extension of the present theory may be fruitful with regard to the *encoding* of memory traces that later may become constituents of episodic memories. As retrieval is a search among memory traces, it is necessary that the selection process of elements that are encoded is determined by the same factors that later trigger and guide the construction of episodic memories (Tulving & Thomson 1973; Wagner et al. 1998). If the role of episodic memories is to provide proof for reliable information through asserting epistemic authority, and as M&C argue, "contextual elements that … make verification possible … allow one to be perceived as more convincing" (sect. 3.1.1, para. 7), then parts of a situation that may make reporting it later as authentic should be more likely encoded in the first place.

According to M&C's proposal, episodic memory is useful for keeping social commitments, an essential part of human social life. Recalling an episodic memory aims to serve as justification for the authentic nature of our belief, and it may be scrutinized by our interlocutor. Therefore, we can apply self-directed epistemic vigilance beforehand to assess the likelihood that the interlocutor would accept the content as legitimate. In their conceptualization, following the argument of Cosmides and Tooby (2000), in human communicative interactions it is useful to maintain the causal history of first-person beliefs.

We suggest that in order to retain the causal history of beliefs, encoding processes need to be sensitive to potential aspects of a situation that can be retrieved when an episodic memory is formed – which also enables avoiding assertions that would lead the social partner to decline our claims of epistemic authority. This applies to the causal history of first-person beliefs that M&C discuss, but it is also necessary with regard to third-person beliefs. The latter is especially important because, although it may happen that we have no prior communicative episode with the social partner, assertions of epistemic authority are in fact often preceded by a history of interactions with the addressee.

This notion appears in M&C's examples as well (e.g., sect. 3.1.1, para. 1): John and Jenny are on a walk, and Jenny expresses her belief that they might have left the oven on at home. John replies, "Don't worry, I remember that we turned it off." In this communicative episode, the reference to remembering makes Jenny both (1) accept John's belief as true and (2) change her own belief as well. However, this assertion may not be as effective if Jenny had also expressed that her worries emerged from remembering that she saw the oven working right before they left the apartment; if Jenny did not remember that John has indeed been in the kitchen that morning; or especially if she had reasons to think that John in fact *did not* go into the kitchen. Consequently, for such arguments to be successful, it is necessary that the communicator not only retrieve and use information about the source of her or his first-person beliefs, but also select information potentially relevant and adequate for persuading the partner, which could be done only in relation to the communicative partner's access to the events in question.

For successful construction of episodic memories that are used in communication, one therefore often has to encode not just *any* contextual detail, but track information *in relation to* a specific social partner. To later recall information that is relevant for that social partner, one must – at the time a specific episode takes place – select, encode, and store (and, often, *index*) – those elements to a specific person. Additionally, one must take into account any aspects of the event that may potentially contribute to the later construction of the episodic memory related to that communication encounter.

A further challenge is to describe what enables the identification of relevant memory traces at reconstruction. M&C argue that episodic memory requires not only the understanding that seeing leads to knowing, but further that seeing validates claims about knowledge. We propose that in order to bridge encoding and retrieval, online theory of mind (by which we mean real-time, continuous belief monitoring) has to support the encoding of information potentially relevant to the basis of belief formation. Episodic memory "hooks" onto these elements (of the causal history of belief formation for the social partner's belief), and if a later cue refers to these bases of previously formed (attributed) beliefs, this enables the collection of adequate components of episodic memory. Importantly, this process requires the reidentification of the social partner, and the attribution of the social knowledge base and monitoring of potential differences between the self and the partner. Altogether, this mechanism increases the (perceived) veridicality of episodic beliefs reported in a communicative interaction.

The suggested interdependence between episodic memory and theory of mind opens novel perspectives with regard to the developmental trajectory of both domains. Namely, the emergence of episodic memory retrieval would be bootstrapped by communicative situations (e.g., Southgate et al. 2010) especially when mindreading is involved; and relatedly, the mindreading system could learn to update previously attributed beliefs according to relevant new information (Király et al., in preparation) through the emergence of episodic memory.

NOTE

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Carving event and episodic memory at their joints

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Abstract: Mahr & Csibra (M&C) argue that event and episodic memories share the same scenario construction process. I think this way of carving up the distinction throws the baby out with the bathwater. If there is a substantive difference between event and episodic memory, it is based on a difference in the construction process and how they are organized, respectively.

In the target article, Mahr & Csibra (M&C) challenge overly cognitive accounts of episodic memory based on the mental time travel metaphor. Instead, they offer a social-cognitive function of episodic memory in terms of an epistemic attitude that signals testimonial authority in human communications. I applaud the proposed shift in focus toward the social-cognitive functions of episodic memory, and I suspect that M&C's suggestion may not be the only function of episodic memory in the social domain.

M&C also propose a distinction between event and episodic memory. As they mention, and as I have argued elsewhere (Keven 2016b), the distinction has the potential to resolve the long-lasting debate about whether episodic memory is a uniquely human capacity. If the distinction is proven to be robust, we can understand the mnemonic abilities of young children and nonhuman animals with event memory without ascribing to them a capacity for full-blown episodic memory. However, it is not clear how to distinguish event and episodic memory at this stage. M&C suggest that event and episodic memory share the same scenario construction process, whereas I think the type of construction involved in episodic memory is *different in kind* from that of event memory. We can distinguish at least four different types of organization that could be utilized in memory reconstructions:

1. **Spatial organization:** We perceive the world in a spatially organized way and can recall our experiences as such.
2. **Temporal organization:** Experiences occur sequentially in time, such as before or after another event. When we reconstruct an experience from memory, the events should occur in their proper place in the sequence.
3. **Causal organization:** Events can be distant in time and yet can have causal connections with each other. I remember that I missed my bus to Istanbul because my alarm didn't ring. Missing the bus and the malfunctioning alarm clock are two temporally distant events that are causally connected in my memory reconstruction.
4. **Teleological organization:** Temporally distant and causally disparate events can still be connected with each other based on goals. For instance, I remember that I was going to give a talk when I missed the bus, so I took a plane instead to get there in time. Although giving a talk is temporally distant and causally disparate from the malfunctioning alarm clock and missing the bus, it is still connected to them in my memory as my goal at the time.

In M&C's view, both event and episodic memory involve construction of a scenario that involves simulation of events that are extended in time and space. It is not clear whether these simulations involve all of these four types of organization. If they want to maintain that young children and other nonhuman animals have event memories, however, then there have to be some differences in the construction of event and episodic memories. Even though there is some evidence that nonhuman animals can be sensitive to temporal information (e.g., Babb & Crystal 2006; Clayton & Dickinson 1998), it is far from clear whether this amounts to an ability to temporally sequence events into before and after relations (McCormack & Hoerl 2011; Roberts & Feeney 2009). Moreover, causal understanding of our primate cousins is very limited, and no nonhuman animals seem to understand the behavior of others in terms of goals (Penn & Povinelli 2007; Penn et al. 2008; Povinelli 2000; Tomasello et al. 2005; Visalberghi & Tomasello 1998). Similarly, young children show less temporal sequence knowledge and omit causal relations between events in their recall of novel experiences, and their memory representations are not organized around goals to the same extent as are older children's and adults (e.g., Price & Goodman 1990; Ratner et al. 1986). So, it is unlikely that event memories in young children and nonhuman animals can involve temporal, causal, and teleological organization.

In earlier work (Keven 2016b), I provided evidence and argued in favor of carving up event and episodic memory in a different way. According to the dual systems thesis that I proposed, event memory is a snapshot-like memory system based on perceptual processes predominantly in the form of visual images. These perceptually grounded representations are highly accurate but short-lived. Construed as such, event memories involve only spatial organization. Any other type of organization is not necessary in this case, as there are no series of events that are extended in space and time.

However, construction of episodic memories requires a higher order *inferential process*. Episodes generally consist of a series of events that are extended across different times and places. When I remember the missing-the-bus episode, I don't remember all of the minute details involved in the actual experience; I remember only the causally and teleologically relevant ones in the right temporal order. To connect such a series of events, the construction process needs to sort the events into cause and effect and goal-attempt-outcome relations, besides keeping track of each scene's spatial structure and the event's temporal order. Organizing memories in this way requires making higher-order inferences on the relations between events from memory as these relations are not directly observable. According to the dual systems thesis, this inferential process is closely tied to our storytelling capacity as narrative has nearly all of the organizational components one would expect. Reconstructing a narrative version of the experience provides the required temporal, causal, and teleological organization. As such, episodic memories are lower in accuracy but can span longer timescales and are more memorable.

To sum up, when we consider different types of organization that can be utilized in memory reconstructions, construction of event and episodic memories differ in kind. In particular, the construction of episodic memories requires a higher-order inferential process, which is unlikely to be found in event memories.

Episodic memory solves both social and nonsocial problems, and evolved to fulfill many different functions

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

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