AUTHORS' VERSION (SUBJECT TO FINAL EDITS)

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1. Johannes Mahr, Gergely Csibra.

2. Abstract: 60, Main Text: 996, References: 432, Total: 1517

3. **Morgan's Canon is not evidence.**

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10. **Abstract**. Mahr and Csibra's account of the communicative function of episodic memory relies more heavily on the case *against* episodic memory in nonhumans than their description suggests. Although the communicative function of episodic memory may be accurate as it pertains to *human* behaviour, we question whether Morgan's Canon is a suitable foundation on which to build theories of supposedly human-specific traits.

11. Main text.

Mahr and Csibra's account rests in part on the literature on human cognition but *stands full weight* upon Morgan's Canon – namely that in non-human behaviour it is to the simplest levels of explanation that we must first appeal. Our approach is not to argue that the authors' thesis is wrong. However, Morgan's Canon does not permit a *rejection outright* of higher

cognitive processes in other species, because it is not evidence. Therefore, *the unfalsifiability of Mahr and Csibra's account correlates perfectly with the 'provability' of the presence of episodic memory in non-linguistic species*. The Canon is at best a sort of subjective (and likely anthropocentric) 'Bayesian prior', with a theoretically tenuous default setting of zero. We briefly present the case against zero, and for reasons of space focus on only two species: scrub jays and rhesus monkeys.

Mahr and Csibra's definitions of episodic memory and autonoesis are intrinsically human-specific, so we adopt a broad, 'traditional' definition of episodic memory as the integrated knowledge of what, where and when ('WWW') something occurred, coupled with a sense of recollection or re-experience (autonoesis) when accessing this information. The authors redefine autonoesis somewhat more specifically than this, as an outcome of the metarepresentation of a scenario under the 'epistemic attitude of remembering'. We thus briefly examine evidence for WWW memory and the metarepresentation of memory, the latter being as close as empirical research on nonhumans can presently get to the authors' own definition, and invite the reader to draw their own conclusion.

WWW memory has been observed in a number of species (see Cheke & Clayton, 2010, for a review), but it is in scrub jays that it has been most thoroughly examined. Jays selectively recovered cached food according to *when* they had cached (i.e. if too long a time has passed, the worms have perished but the peanuts are fine), *what* it was (worms are tastier than peanuts, given the choice) and *where* they had buried it (Clayton & Dickinson, 1998, 1999b). Moreover, they can flexibly adapt to recover food types they have not recently been fed to satiety on (Clayton & Dickinson, 1999a), show flexible awareness of the rate at which different food types decline in freshness (Clayton, Yu & Dickinson, 2001) or improve as they

'ripen' (de Kort, Dickinson & Clayton, 2005), can update their information about cached foods even between caching and recovery (Clayton, Yu & Dickinson, 2003), show awareness of which individuals may have been watching them while they cached (Dally, Emery & Clayton, 2006), and can dissociate the location of specific food from other, less preferred food in the same container (Clayton & Dickinson, 1999b). Clayton and her colleagues, mindful of the autonoetic component of episodic memory that only language-users can realistically convey, termed this 'episodic-like' memory (see also Clayton & Russell, 2009). Overall, this pattern of results suggests the jays form an integrated and cognitively rich WWW memory (de Kort et al., 2005). Moreover, this memory is grounded in the jay's own agentive experience. This need not be a trivial point – the ability to judge a signal as unreliable, even from a conspecific (e.g. Cheney & Seyfarth, 1988), suggests there is theoretical utility in retaining some aspect of the self as the source of information.

Secondly, there is also by now a substantial body of evidence suggesting nonhumans can metarepresent their own memory - essentially 'know what they remember'. Rhesus monkeys are the species for which the greatest amount of evidence is available. For example, in delayed matching-to-sample tests, the subject is presented with a stimulus to remember and then given a multiple-choice memory task after an intervening delay. The subject is either forced to take the test, or given the opportunity to 'opt out' before doing so. Rhesus monkeys show evidence of greater accuracy on memory tests they chose to take than on memory tests that were forced (Hampton, 2001), and are more likely to 'bet' more on tests they are about to answer correctly, or feel they have already answered correctly (Morgan, Kornell, Kornblum & Terrace, 2014), suggesting that they could assess their own memories, even in the absence of the stimuli themselves, and choose to take tests when their confidence was relatively high. In another task, rhesus monkeys were presented with a number of tubes and either witnessed

one of them being baited with food, or had no knowledge of which tube the food was in. The monkeys were more likely to look into the tubes first when they had no memory of where the food was than when they had seen the baiting, indicating that they 'knew when they didn't know' (Basile, Schroeder, Brown, Templer & Hampton, 2015; Templer & Hampton, 2012; See also Hampton & Hampstead, 2006). Moreover, these apparently metacognitive judgments have been shown to transfer across different tasks, lending weight to the argument that they are cognitively independent of associative learning and stimulus- or task-specific factors (Kornell, Son & Terrace, 2007; Morgan et al., 2014).

Crucially, we do not claim that nonhuman animals *must* have episodic memory, or metamemory (Hampton, 2009), and we retain that the authors' central argument may be correct, particularly as it pertains to humans, and may furthermore be testable. For example, in English we can make the distinction between the episodic past (e.g. 'I remember posting the letter') versus non-episodic past (e.g. 'I remembered to post the letter'). One possible test of the authors' account could involve asking which sentence was more 'ill-willed' when the participant knew the speaker was lying. Insofar as we may tie our reputations to the mast of our epistemic authority, we suspect the majority would be particularly irked by the invocation of specifically episodic rather than semantic memory in 'I remember posting…'. However, the validity of the human story rests on the invalidity of the nonhuman one. Whether we should begin to look in more detail at the crux of the Mahr and Csibra's profoundly *human* account of episodic memory, we leave to the reader to decide.

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