Episodic recollection before and after self-recognition

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Adult episodic memory involves consciously re-experiencing oneself in contextually rich reconstructions of past events. Developmental research still debates when young children (Newcombe et al., 2014) or infants (Behm et al., 2025) start forming contextually specific memories, binding "*what* happened" to "*where* and *when* it happened", but there is a consensus that episodic-like memories emerge years before children show reliable self-conscious recollection around the age of four. Yet experiments such as the mirror self-recognition task (Rochat, 2003) suggest that a conceptual self-awareness emerges between 18 to 24 months. Mirror self-recognition has been found to predict memory for a location (Howe et al., 2003), and together with maternal reminiscing style, later episodic memory (Harley & Reese, 1999). One proposed mechanism is that the self-concept may serve as an anchor around which memories can be organized – which later in development also facilitates conscious re-experiencing of episodes (Ross et al., 2025). We hypothesized that although conscious episodic recollection may not emerge before much later, the emergence of conceptual self-awareness might already help early binding mechanisms to form precocious episodic-like memories.

Infants (n=130) participated in the study at 12 and 18 months. At 18 months, self-awareness was measured with the mirror self-recognition task, where around 18 months 50% of infants show self-awareness by touching a mark on their face when looking in the mirror (Amsterdam, 1972). Next, episodic-like binding was measured in the 'two-room task' (Newcombe et al., 2014) where children learn the location of two different toys, in two different boxes, in two different rooms. Successful binding is reflected in searching in the box that contained the toy in that room. However, because both rooms contain the same boxes, children sometimes search in the box that contained a toy in the other room; a binding error especially frequent at 18 months. Episodic-like binding was also measured in screen-based eye-tracking tasks at 12 and 18 months, measuring looking time and saccades in response to faces matching (vs. non-matching) scenes they were previously shown with (Richmond & Nelson, 2009), or items matching (vs. non-matching) items they were previously paired with (Johnson et al., 2020) in single exposures. Since some eye-tracking experiments found episodic-like binding already in young infants, we conducted them longitudinally to evaluate their development, and predictivity of binding in the two-room task. Out of N=120 at the 18 months visit N=65 recognized themselves in the mirror, N=52 did not.

One first analysis replicated episodic-like binding in both eye-tracking and interactive paradigms. Participants of the two-room task (N=108) searched the correct box significantly more than chance ($p < .001$). Participants also showed novelty responses in eye-tracking experiments, with no significant difference between 12 and 18 months. Person-context binding showed in both higher looking times ($p = .043$) and saccades ($p = .034$) to matching faces. On the contrary, item-item binding showed in both higher looking times ($p < .001$) and saccades ($p = .016$) to non-matching items. Altogether,

results replicate behavioural signatures of episodic-like binding at the beginning of the second year of life.

Ongoing analyses investigate relations between tasks. A path analysis modelled the development of episodic-like binding in eye-tracking tasks, its relation to binding in the two-room task, and the relation of these to self-recognition. Binding novelty responses, in eye-tracking tasks, showed negative predictions from 12 to 18 months: item-item binding switched from familiarity to novelty preference, suggesting increasing processing efficiency; item-context binding switched from familiarity to novelty preference, which could reflect the opposite, possibly due to processus refinement. Binding in screen-based tasks did not strongly associate with search in the more naturalistic and declarative two-room task, which could reflect the very different task demands, or possibly different memory processes. Most notably, while correct retrieval rates in the two-room task did not relate to mirror self-recognition, error patterns did, with significantly more recognizers committing errors in context-binding (search in the box that contained a toy in the other room), and non-recognizers instead committing random errors (search in box that never contained toys). A pattern that suggests conceptual self-awareness may only indirectly benefit episodic-like memory, either anchoring contextual information only partially (the box but not the room), or generically (across rooms); that is, a still developing capacity for reliable episodic memories.

In summary, episodic-like binding capacities seem to develop before explicit verbal recollection can measure it. Before the offset of infantile amnesia, preverbal infants may already form a wealth of episodic-like, but not yet adult-like, memories. An open question is whether and how such memory may relate to the emergence of autonoetic consciousness, the ability to re-experience oneself throughout contextually rich past events, and to access it explicitly.