The Prioritization of Social Content in Episodic Memory

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Abstract

Episodic memory helps facilitate navigation of the social world. Yet, whether social content is prioritized in episodic memory is unclear. We tested whether social content is prioritized in episodic memory-guided decision tasks. Online volunteers encoded episode triplets comprising a location, activity, and a social group that related to a decision stimulus. Subsequent associative memory tests revealed an enhanced recall, but longer response times, for activity pairings with the social group compared to the location. Additionally, memory-guided social decision-making selectively boosted the primacy of social information under more demanding retrieval conditions. Motivated by these results, we modeled how a bias term in signal detection theory would correspond to holistic pattern completion of triplets at recall as a function of response time. This revealed enhanced information pattern completion when recalling social-content. These results highlight the primacy of social content in episodic memory while offering a putative mechanism for how social content influences episodic memory processes.

Keywords: Episodic Memory, Social Cognition, Pattern Completion, Signal Detection Theory

Introduction

Event attributes such as valence, reward, and risk are known to be prioritized in episodic memory (Bisby and Burgess, 2017; Murty et al., 2016; Zajonc, 1980; Phelps and Sharot, 2008; Madan et al., 2014). Recent work suggests social stimuli might bias recognition memory (Stewardson et al., 2023; Jimenez and Meyer, 2024). Yet, it remains an open question whether hippocampus-dependent episodic memory processes prioritize social content.

We test if social content is prioritized in episodic memory using an adaptation of Bisby et al. (2018) for triplets association, with manipulations for whether participants encoded stimuli in social or non-social memory-guided decision making tasks. After finding a privileged role for social episodic content, we then provide a computational account for how episodic memory binds the triplet elements during recall. We use the model to test if episodic recall for social content provokes more holistic pattern completion mechanisms.

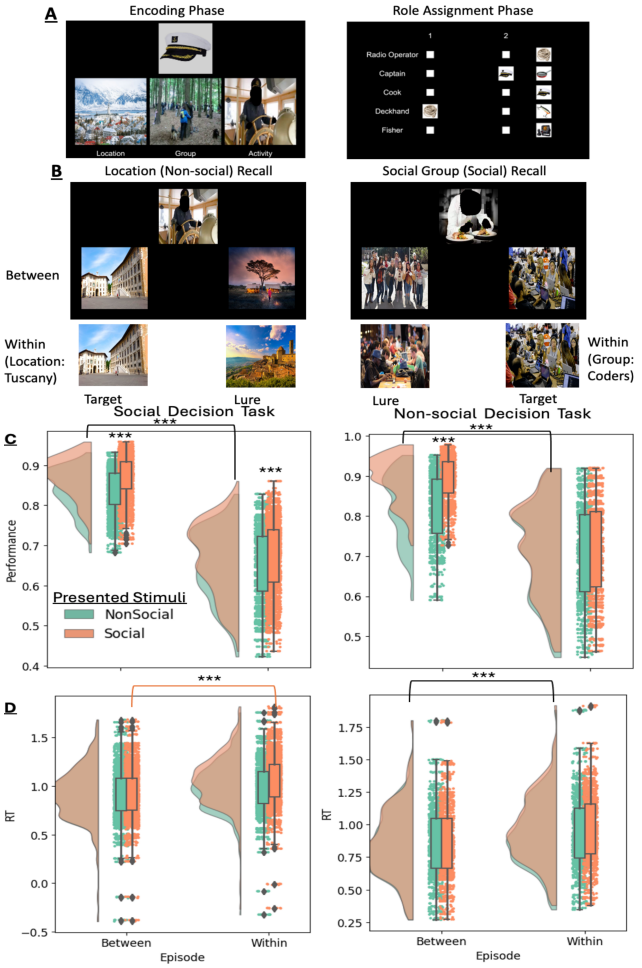

Figure 1: A.) An example memory encoding trial and subsequent decision-making task. A non-social decision task shown; social decision-making task replaces objects with faces. B.) Example episodic memory recall trials divided between activity-social group (social) and activity-location (non-social) associative recall. C.) Recall performance and D.) RT results for each experimental condition. *** indicates $p < 0.001$

Experiment

Two independent set of participants were recruited for two pre-registered experiments on social primacy in either an episodic memory-guided social decision making tasks (N=110) or non-social decision making tasks (N=55) (see fig. 1A,B). Both experiments had an encoding phase where participants created stories from triplets comprising an activity, a social group, and a location linked to either a social (fictitious person) or a non-social (object) decision stimulus. For example: "A curly haired boy with glasses (fictitious person) went to an abandoned parking lot (location) with his suburban friends (social group) to play soccer (activity) after school". There were 5 decision stimuli, with 2 distinct triplets associated with each, adding up to 10 unique triplets in each experimental run. Participants then chose which of 5 labels best represented each decision stimulus. The activity cue presented during the encoding phase was the uniquely informative episode element for these choices. Next, associative memory recall was tested in a 2x2 factorial design, with a factor of social or nonsocial content, and a factor for whether triplet items associated with the same activity (easy), or triplet items associated with different activities (difficult). 40 trials were counterbalanced for this factorial design. The participant rated their recall confidence at each trial. Each experiment contained 2 runs. At the end of the experiment, participant chose the top 2 activity cues they were most familiar with in each run.

We modeled effects of experimental conditions on

response times and recall with a linear mixed effects model with random intercepts for runs and participants. Main effects consisted of whether the recall stimuli was social, whether the target item and the lure were associated with the same activity (i.e. recall difficulty), choice accuracy in the decision making task, and participant familiarity with an activity cue. Interactions between these main effects were modeled as well.

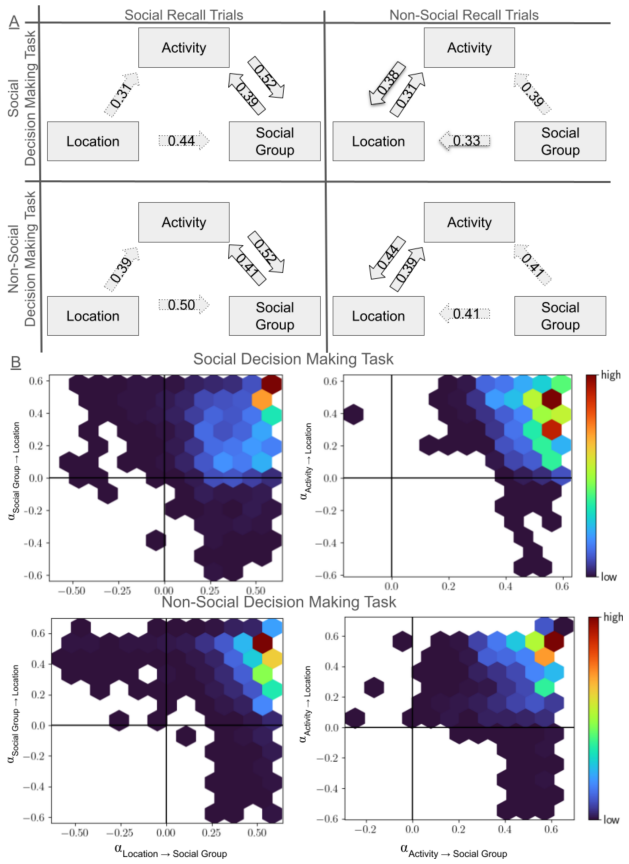

Figure 2: A.) A graph of the expected value of information flow for each trial type(social or non-social recall) and for each decision-making task. Dotted arrow borders refer to hidden stimulus contributions in a memory trial. B.) 2D posterior distribution plots demonstrating how varying information flow from triplet items to non-social recall(y-axis) affects the likelihood of information flow of triplets items in social recall(x-axis).

The Model

We augmented a signal detection model with a bias term ($\hat{C}$) that varies with response time (RT). We refer to a recall item with subscript i and stimulus with s. The proposed approach follows previous models of pattern completion (Horner and Burgess, 2014; Horner et al., 2015; Bisby et al., 2018).

$$\hat{C}_{\mathrm{i}} = \sum_{s \in stimuli} \alpha_{s \to i} C_s \tag{1}$$

Weights (α) were modeled by an inverse logistic function (ψ^{-1}) of response times at a trial (t). Constraints ensured weights add to 1 and that the stimulus being recalled had the largest weight:

$$\begin{aligned} \alpha_{\mathrm{s}\to\mathrm{i}}(t) &= \psi^{-1}(w_{\mathrm{s}\to\mathrm{i}} RT(t) + b_{\mathrm{s}\to\mathrm{i}}) \\ 1 &= \sum_{s \in stimuli} \alpha_{\mathrm{s}\to\mathrm{i}}(t) \\ \alpha_{\mathrm{s}\to\mathrm{s}}(t) &> \alpha_{\neg\mathrm{s}\to\mathrm{s}}(t) \end{aligned} \tag{2}$$

Each trial is testing association recall between two items: An activity cue with either a social or non-social stimulus. Thus, the hit-rate (H) for a memory trial with difficulty $\delta : \{easy, hard\}$ is:

$$\begin{aligned} H(i) &= P(activity)P(i) \\ P(i) &= \phi(\frac{d'_{i,\delta}}{2} - \hat{C}_i) \end{aligned} \tag{3}$$

ϕ is the normal cumulative distribution function. d'–the separation between the signal and noise distribution–is another parameter inferred, and depends both on the recall stimulus and the memory trial difficulty. Hierarchical priors were set on the parameters of the model and posterior distributions were sampled using a Markov chain Monte Carlo.

Results

The linear mixed effects model (fig. 1C,D) confirmed enhanced associative memory for social content in both the social ($t[109] = 3.5, p < 0.001$) and non-social ($t[54] = 5.12, p < 0.001$) decision making tasks, with heightened response times in difficult memory trials ($t[109] = 6.2$ and $t[54] = 5.0$ respectively, $p < 0.001$). Social-decision making tasks maintain enhanced social recall during difficult of memory trials, and where heightened response times only occurred during social recall.

Computational modeling (fig. 2A) uncovered greater holistic retrieval of triplet information when recalling social content regardless of decision making task. When setting non-social recall pattern completion (y-axis) to 0, we still observe high posterior likelihood of pattern completion in social recall (fig. 2B). Crucially, the reverse effect is not seen when setting social recall pattern completion (x-axis) to 0, indicating preferences for holistic recall of event engrams in memory of social content.

Conclusion

We present results highlighting enhanced recall of social content in episodic memory. Surprisingly, response times were also greater for social content. A computational model of response times provides a mechanistic account of how social elements promote more holistic pattern completion of event engrams, yielding prioritization of social content in episodic memory.

Acknowledgments

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