Replay of Incidentally Encoded Episodic Memories in the Rat

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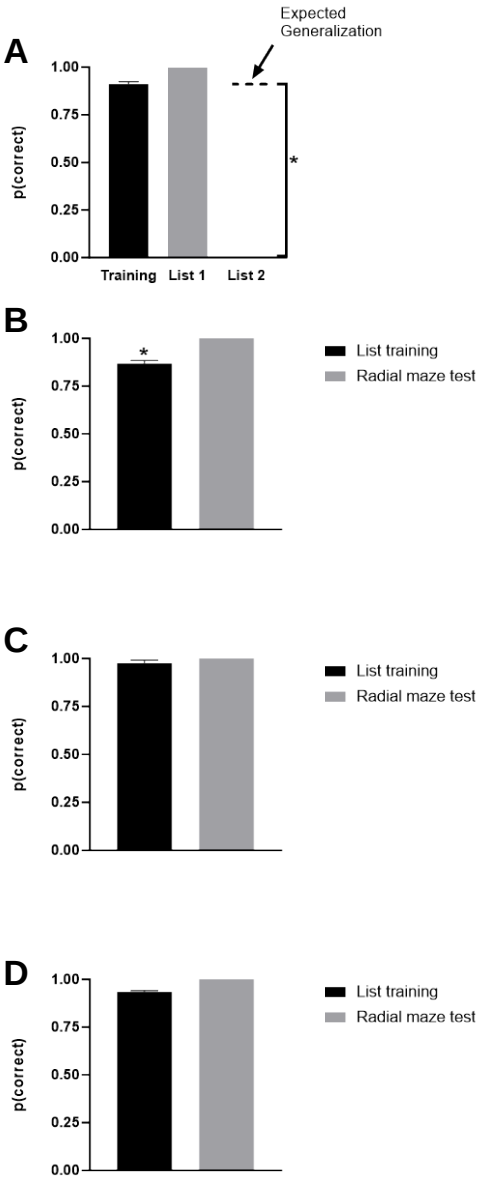
Although events are not always known to be important when they occur, people can remember details about such incidentally encoded information using episodic memory. Importantly, when information is explicitly encoded for use in an expected test of retention (as in most assessments in animals), it is possible that it is used to generate a planned action; thus, the remembered action can occur without remembering the earlier episode. By contrast, when a test is unexpected, transforming information into an action plan is unlikely because the importance of the information and the nature of the test are not yet known. Thus, accurate performance in an unexpected test after incidental encoding documents episodic memory. In our earlier work on replay of episodic memory, rats were presented with a list of trial-unique odors and were trained to pick items that occupied particular ordinal positions from the end of the list. Because the length of each list was unpredictable to the rat, searching the content of episodic memory from the end of the list to find the odor that occupied a particular ordinal position was encouraged. The proposal that rats used episodic memory is supported by successful memory after a long delay and interference, equivalent performance under varying memory load demands, and evidence that inhibiting neurons in the hippocampus impaired list memory while sparing other aspects of odor memory. However, exclusive use of replay of episodic memory is difficult to establish because other potential mechanisms may be engaged by repeated training. In our current approach, we present a sequence of odors in a setting where the animals had been trained to perform a different memory problem, thereby minimizing the influence of these other mechanisms. In one task, rats reported the third last item in an explicitly encoded list of trial-unique odors. In a second task, rats foraged in a radial maze in the absence of odors. On a critical test, rats foraged in the radial maze, but scented lids covered the food. Next, memory of the third last odor was assessed. All participating rats correctly answered the unexpected question after 0- and 15-minute delays (Figures 1A and 1B). To test the hypothesis that the rats were not automatically encoding odors for the purpose of answering a memory assessment (stimulus generalization) during the critical test, we conducted two additional control conditions. In one control condition, we gave rats a list of items in a trained encoding context, followed by a list of items in a novel encoding context. Next, rats were transferred to the memory assessment context and given a choice between the third last item from list 1 and the third to last item from list 2. All participating rats chose List 1 (Figure 1C). In a different control condition, we used entirely novel odors during the critical test. All participating rats correctly answered the novel odor memory assessment (Figure 1D). We conclude that rats replay episodic memories of incidentally encoded information in an unexpected assessment of memory. These results suggest that rats encode multiple pieces of putatively unimportant information, and later replayed a stream of episodic memories when that information was needed to solve an unexpected problem.



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