Learning in Amnesia

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Introduction

We compared learning by amnesic and control participants in the "Weather Prediction" task, a widely-used probabilistic categorization task. Earlier studies with the WP task (e.g., Knowlton et al., 1994) found no difference in early categorization performance between amnesic and control participants. This has been taken as evidence for a multiple memory systems view, in which categorization learning is dependent on implicit memory, which is unimpaired in amnesia. However, earlier research used measures of explicit knowledge of questionable validity, and focused only on the outcome of learning, rather than the learning process itself. To overcome these problems, we tapped two relevant aspects of explicit knowledge: *task knowledge* (knowledge of the relations between cues and criterion) and *self-insight* (knowledge of the relations between cues and response). If learning depends on implicit memory at least one of these should yield minimal evidence of awareness.

By using a dynamic lens model approach, we conducted a fine-grained analysis of learning. The lens model offers a general framework to study information utilization and its relation to the contingencies in the learning environment. It does so by fitting two models simultaneously, one to the cues and criterion, and one to the cues and responses. To study learning, past research has used "rolling regression" models (e.g., Lagnado, Newell, Kahan & Shanks, in press). In the present study, we used associative and Bayesian learning models. These are models for on-line learning, in which cue validities are estimated on a trial-by-trial basis.

Method

Twenty-five participants (9 amnesic and 16 control) took part in the study. Control participants were matched to amnesic participants on age, education and intelligence. The WP task consisted of 200 trials, on each of which participants were presented with a pattern of one, two or three cards. Each trial was associated with one of two outcomes (Rain or Fine), and the learning set was constructed so that each card was associated with the outcome with a different probability. Once they had made their prediction, participants received immediate feedback as to the actual weather on that trial, and whether they were correct or incorrect. After each block of 50 trials, participants judged the probability of Rain given each card, as well as the importance of each card for their predictions.

Results

A 1 between (group) × 1 within (trial block) ANOVA on categorization performance showed a significant effect of block, $F(3,69) = 6.96$, $p < .001$. There was no significant effect of group, $F(1,23) = 2.49$, nor a significant interaction between block and group, $F(3,69) = 0.34$. Hence, the groups were indistinguishable on categorization performance.

The best fitting learning model was an associative model with a separate (constant) learning rate for each participant. Dynamic cue utilization profiles showed no qualitative differences in learning strategy. Both groups learned to integrate the information adequately to form predictions.

By the end of the task, both groups showed accurate task knowledge, and judgments of the contingencies were significantly correlated to the model-based predictions, $r = 0.43$, $t(398) = 9.55$, $p < .001$. As such, participants' inferences corresponded to what they could have rationally inferred, given their experience in the task. Taken together, we found no evidence for impaired explicit task knowledge in amnesia.

Self-insight was assessed by comparing importance ratings to the cue utilization weights. Trend analysis showed that judged cue importance increased linearly with cue utilization, $F(1,98) = 5.20$, $p < .05$. There was no significant interaction between trend and group. Hence, both groups showed adequate self-insight, and again we found no group differences.

Discussion

We replicated earlier findings of unimpaired categorization performance in amnesia. In contrast to earlier findings, we found no evidence for impaired explicit knowledge, in terms of task knowledge or self-insight. Hence, we found no evidence for multiple memory systems in probabilistic category learning. Instead, our results and those found earlier can be explained in a single system view of memory, in which learning may be slightly slower in amnesia, but not qualitatively different.

References

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