

On the Role of Temporal Context in Human Reinforcement Learning

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Abstract

Attractor network models of associative learning provide a plausible scenario for the formation of context-dependent associations. Such models make a strong qualitative prediction for temporal context: the learning of associations encompasses not only current inputs but also reverberant ‘delay activity’. This implies that learned associations will include the temporal sequence of input events, whether task-relevant or not. Indeed, learning of task-irrelevant sequence information is observed in behaving non-human primates. This thesis aims at confirming and extending the above findings to human observers, in order to formulate additional constraints for attractor network models.

We investigated how temporal context affects the learning of arbitrary visuo-motor associations. Human observers viewed highly distinguishable, fractal objects and learned (by trial and error) to choose for each object the one motor response (out of four possible) that is rewarded. Temporal context was introduced through the sequence of objects: some objects were consistently preceded by specific other objects, while other objects lacked this task-irrelevant but predictive context.

The results of five experiments showed that predictive context consistently and significantly accelerated associative learning. A simple model of reinforcement learning, in which three successive objects informed response selection, reproduced our behavioral results.

Our results imply that not just the representation of a current event, but also the representations of past events, are reinforced during conditional associative learning. In addition, these findings are broadly consistent with the prediction of attractor network models of associative learning and their prophecy of a persistent representation of past objects.