Modelling "Minimal cross-trial generalisation in learning the representation of an odour-guided choice task" by Song et al.

The referenced paper tested how rats represent an odour-guided choice task in which two odour cues indicated which of two responses would lead to reward, whereas a third odour indicated free choice among the two responses. The results demonstrated the importance of formally testing possible task representations that can afford the observed behaviour, rather than assuming that animals' task representations abide by the generative task structure that governs the experimental design.

In our modelling of the paper, we implemented two different reinforcement learning (RL) models with different state representations of the task and tested how well they predicted the trial-by-trial choice behaviour for each animal. What differed between the two models is the assumed state representation, i.e. whether and how learning generalised across odours.

The four-state model assumed full generalisation between valid responses on forced-choice trials and corresponding responses on free-choice trials, with shared states between them; this model correctly reflects the generative structure of the task. On the other hand, the six-state model assumed no generalisation between trial types, with separate states based on odour and action.

The free parameters of each model were fit to choose data from all animals using hierarchical Bayesian inference with Markov Chain Monte Carlo (MCMC) sampling. We evaluated model fits using the Watanabe–Akaike information criterion (WAIC). We ran simulations for both the models and then compared them. This comparison showed clear evidence for the six-state model, which out-performed the four-state model with a WAIC score that was 1211±78 (mean ± standard error across samples) lower.