Abstract

Cognitive science draws inspiration from a myriad of disciplines, and has become increasingly reliant on computational methods. In particular, theories of learning, operant conditioning and decision making have shown a natural synergy with statistical learning algorithms. This offers a unique opportunity to derive novel insight into the conditioning process by leveraging computational ideas. Specifically, ideas from Bayesian Inference and Reinforcement Learning.

In this thesis, we examine the statistical properties of associative learning under uncertainty. We conducted a neuropsychological experiment on over 100 human subjects to measure a suite of executive functions. The primary experimental task (Card Sorting) gauges one's ability to learn, via inference, the structure of some latent pattern that drives the decision making process.

We were able to successfully predict the subjects' behaviour in this task by fitting a Bayesian Reinforcement Learning model, alluding to the mechanics of the latent biological decision generating process and executive functions. Primarily, we detail the relationship between working memory capacity and associative learning.

Keywords: Cognitive science, mathematical psychology, computational psychiatry, reinforcement learning, Bayesian inference, machine learning.