Mammalian decisions

Pete Trimmer, John McNamara, Alasdair Houston, James Marshall, Liz Paul, Rafal Bogacz and Mike Mendl

University of Bristol
trimmer@compsci.bristol.ac.uk

We study a simple scenario in which optimal decision-making requires a trade-off between speed and accuracy. Our analysis is set in the context of a mammal deciding whether to forage or invoke anti-predator action following an ambiguous cue. We assume that the brain has two systems which can make decisions. Thalamic decisions are fast but are less accurate than cortical decisions (which take longer).

We idealise the analysis by assuming that: 1) Thalamic decisions are made immediately, based upon a single piece of information (represented using Signal Detection Theory). 2) Cortical decisions are made by gathering information continuously until a confidence-threshold is reached (represented by applying a single-boundary version of the Sequential Probability Ratio Test to Brownian Motion with drift).

Following the analysis of each process in isolation, we examine how such decision systems might best be combined and used in the brain, discussing results in the context of information flow and the phylogeny of the mental architecture. We find that in some circumstances, if one system is weakened, the other system can largely compensate, thereby producing similar overall performance but with a different likelihood of response and decision timing.

The work may help to open areas of research on several topics, such as selective attention, mental stress and how learning affects decision-making (and vice-versa).