The optimal time to approach an unfamiliar object: a Bayesian model

Tom N. Sherratt1, Ian Dewan2, John Skelhorn3, Frances Sherratt4

1Department of Biology, Carleton University, Ottawa; 2Department of Evolutionary Theory, Max Planck Institute for Evolutionary Biology, Plön; 3Biosciences Institute, Faculty of Medical Sciences, Newcastle University, Newcastle; 4Department of Neuroscience, Carleton University, Ottawa.

Many organisms hesitate before approaching unfamiliar objects. This caution forms the basis of some well-known assays in the fields of behavioral ecology, neuroscience and animal welfare. In this talk I present a mathematical model which identifies the optimal time an observer should wait before approaching an unfamiliar object. The model is Bayesian, and simply assumes that the longer the observer goes without being harmed, the lower will be the observer’s estimated probability that the unfamiliar object is dangerous. Given the information gained, a time is reached at which the expected benefits from approaching the object exceed the expected costs. The model not only explains why latency to approach may vary with the object’s appearance, but also why individuals habituate to any unfamiliar stimulus. I demonstrate the applicability of the model by fitting it to published data on the time taken by chicks to attack artificial caterpillars which share no, one, or two signaling traits with snakes. I use the example to show that while the optimal time to approach an unfamiliar object reflects the observer’s expectation that the object is dangerous, the rate at which habituation arises is also a function of the observer’s certainty in their underlying belief.