The Evolution of Bayesian Priors in Uncertain Environments

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Earlier research has cast the dilemma that predators face when deciding to sample unfamiliar prey as a two-armed bandit. If the predator chooses to reject the prey item, it incurs no cost, but gains no information about the profitability of the prey type. If the predator accepts the prey item, it gains an immediate payoff (a benefit or a cost) and information about the profitability of the prey type. Beginning with uniform priors and assuming Bayesian learning, it is possible to identify the optimal predator decision for any informational state (e.g. three of four prey items accepted are unprofitable). However, prior beliefs are rarely uniform and are subject to natural selection. We therefore extend the approach by identifying the optimal priors of predators for different foraging environments. For example, if red prey were on average costly to attack then one would expect predators to evolve a prior that would encourage it to quickly learn to avoid them. We derive the distributions of priors that are be selected in any given environment. We apply these insights to help understand why humans are more likely to learn to avoid unfamiliar unprofitable prey when they are conspicuous compared to when they are cryptic.