

Title: Computational models reveal how cleaner fish adjust decisions in a biological market

Abbreviated title: Cleaner fish cognitive mechanisms in a biological market

Abstract

While it is generally straightforward to quantify individual performance in cognitive experiments, identifying the underlying cognitive processes remains a major challenge. Often, different mechanistic underpinnings yield similar performances, and Lloyd Morgan’s cannon warrants acceptance of the simpler explanation. Alternatively, when the different mechanisms interact with environmental conditions, variation in performance across environments might allow to statistically infer the mechanism responsible. We illustrate this point by fitting computational models to experimental data on performance by wild-caught cleaner fish *Labroides dimidiatus* in an ephemeral reward task, as well as cleaner and client fish densities from the locations of capture. Using Bayesian statistics to fit the model parameters to performance data revealed that cleaner fish most likely estimate future consequences of an action, while it appears unlikely that the removal of the ephemeral reward acts as psychological punishment (negative reinforcement). Incorporating future consequences also yields performances that can be considered the result of locally optimal decision-rules, in contrast to the negative reinforcement mechanism. We argue that the combination of computational models with data is a powerful tool to infer the mechanistic underpinnings of cognitive performance.