

OR256

Multi-criteria decision making in slime mould amoebas and ant colonies

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When making decisions, organisms may need to consider multiple criteria, some of which may be in conflict. For example, the best restaurant may also be the most expensive, the cheapest house might have the longest commute, and the tastiest food might be the most fattening. How do group-level cognitive systems such as slime moulds and social insects deal with multi-criteria decision-making? In this talk I will discuss two types of multi-criteria decision-making: choosing a meal and building a transportation network. In the first half of the talk, I will discuss multi-criteria decision making in the giant amoeba, *Physarum polycephalum*. Despite being brainless, slime moulds are capable of making trade-offs between risk and food quality, are subject to speed-accuracy trade-offs, and even exhibit human-like irrationality when confronted with irrelevant decoy options. In the second part of the talk I will discuss another kind of multi-criteria problem: designing transportation networks. Building a good network is challenging because desirable network features such as low cost, travel efficiency and robustness to damage cannot be optimised simultaneously. We studied network topology in two species of ant: argentine ants (*Linepithema humile*) and meat ants (*Iridomyrmex purpureus*). The two species had different ways of dealing with the trade-offs of transportation network design. In lab experiments, we found that argentine ants built low cost networks using the minimal amount of trail, at the expense of robustness. In contrast field colonies of meat, built trail networks that balanced efficiency and cost.