



Division of labor applied to cooperative foraging by ants and robots

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Division of labor by age polyethism, caste specialization or positive reinforcement plays a central role in the ecological success of insect societies. In ants, specialized workers carry out complementary tasks during nest maintenance, defence against intruders or foraging. Here, we applied a similar strategy in the field of animal-robot interactions and investigated the collaboration between *Lasius niger* colonies and robots during foraging. This mixed society should benefit from the exploration pattern of the ants to discover food sources and the ability of the robots to rapidly convey these resources to the nest to fasten their exploitation. We developed sensors to track the activity at the nest entrance and automatically detect the recruitment dynamics displayed by the colony once a resource has been discovered. By sampling over appropriate time periods, the sensor is able to discriminate the peak of activity associated with the recruitment of nestmates among the natural fluctuations of the foragers flow. Once detected, this signal is transmitted to the mobile robot that starts to search for the feeder by following the ants and bring it back to the nest once loaded. To demonstrate the potential of such methodology, we first compared the exploitation of a 1M sucrose feeder placed 1m in front of the nest with and without the help of the robot. In the presence of the robot, the feeder was brought back to 10 cm of the nest once discovered, reducing by a factor of 5 the duration of the trips between the feeder and the nest. Then, we designed a binary choice experiment by hiding the feeder behind one of two screens placed in the environment. In this case, we demonstrate the bidirectional transfer of competence between the insects and the robot that selects the correct hiding place thanks to the higher density of ants. This synergy demonstrates the possible applications of division of labor in animal-robot interactions with each community playing to its strengths.