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Refereed Article

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A Study of Ants' Numerical Competence

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Abstract: *The main point of proposed approach to study ants' cognitive abilities is that our experiments provide a situation in which insects have to transmit information quantitatively known to the experimentalist, in order to obtain food. One may measure the complexity of tasks they solved in order to pass definite pieces of information from scout ants to foragers.*

*Our previous experiments, basing on ideas of Information Theory, had shown that aphid-farming ants (*Formica polyctena, F. sanguinea, Camponotus saxatilis*) are able to memorise and transmit messages concerning sequence of turns towards a hidden trough of syrup and to use the simplest regularities to compress the information.*

*In the experiments placed here counting and number related skills are described. We selected the most high social red wood ants (*Formica polyctena*) to transmit information (1) on the ordinal number of a given side-branch in a linear maze and (2) on the numerical co-ordinates in a grid-type maze of a node at which syrup has been hidden.*

One of the experimental set-ups consisted of a "tree-trunk" with branches that ended in empty troughs, except for one which was filled with syrup. Another set-up consisted of a lattice of grid, in which location of a goal-node relative to a start-node can be specified as a pair of Cartesian coordinates. The foragers of F. polyctena *were separated into teams of 5-8 individuals, each with one scout. All laboratory ants were marked with coloured labels. To start the experiment, an ant scout was placed at a randomly numbered trough containing food and then allowed to return to the nest on its own. The duration of the ensuing contact between foragers and the scout was measured. Then we removed the scout and the foragers had to search for the food by themselves. The experiments were so devised as to eliminate all possible ways that may help to find food, except for distant homing. The consistently high success of the foragers in finding the food suggests that scouts are able to count within a range of several tens, and to transmit this information to their foragers. Analysis of time duration of ants' contacts enable us to hypothesise how they use numbers and numerical co-ordinates in their communication.*

Publication and review history

This work was first presented at the Machine Intelligence 18 Workshop, held on September 19-21, 2001 at the University of York, UK. Attendance at this workshop was based on invitations. Speakers at the workshop were invited to submit their articles for consideration in the forthcoming workshop volume. The subsequent publication and review history for the present article was as follows.

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