Field study suggests brain size in ants adheres to specialization hypothesis

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Acacia ants (Pseudomyrmex ferruginea). Credit: Ryan Somma/Wikipedia.

(Phys.org)—A small group of researchers working in conjunction with the Smithsonian Tropical Research Institute in Panama has found that for at least one type of ant, the specialization hypothesis appears to apply regarding brain size. In their paper published in *Proceedings of the Royal*

Society B, the team describes their study of various sized ant colonies and ant brains, and what they learned in doing so.

Scientists have noticed over the years that organisms that live in colonies tend to have larger brains when the colonies are larger, which has begged the question of whether it's a colony wide phenomena (brain growth would be due to the need for maintaining social connections) or if it differs by group member specialization (because of a need to learn the skill involved)—the first has led to what is known as the Social Brain hypothesis (SBH), the latter the Task-Specialization hypothesis (TSH). In this latest effort, the researchers looked to find the answer, at least for one species, by traveling to Panama to study acacia ants—they live in the hollows of acacia trees.

The ants made good study subjects because the size of their colonies varies. Also, prior research has shown that there are at least two kinds of jobs done by the ants, some workers hang around the base of the tree warding off predators while other workers forage on the leaves of the tree—thus there are two distinct classes of ants in any single colony, unless the colony is small—in that case worker ants are forced to perform both jobs.

To find out which hypothesis might apply to the ants, the team ventured to the Parque Natural Metropolitano in Panamá City and studied the activity in 17 different colonies for three months, and also measuring the brains of 34 trunk ants and 29 leaf ants. They found that as the size of the colony increased, the size of the brains of the leaf ants grew as well (most particularly the regions responsible for memory and learning), but the brains of the trunk ants did not. Thus, it was clear that at least for acacia ants, brain size appears to adhere to TSH.

More information: Specialization and group size: brain and behavioural correlates of colony size in ants lacking morphological

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ABSTRACT

Group size in both multicellular organisms and animal societies can correlate with the degree of division of labour. For ants, the task specialization hypothesis (TSH) proposes that increased behavioural specialization enabled by larger group size corresponds to anatomical specialization of worker brains. Alternatively, the social brain hypothesis proposes that increased levels of social stimuli in larger colonies lead to enlarged brain regions in all workers, regardless of their task specialization. We tested these hypotheses in acacia ants (Pseudomyrmex spinicola), which exhibit behavioural but not morphological task specialization. In wild colonies, we marked, followed and tested ant workers involved in foraging tasks on the leaves (leaf-ants) and in defensive tasks on the host tree trunk (trunk-ants). Task specialization increased with colony size, especially in defensive tasks. The relationship between colony size and brain region volume was task-dependent, supporting the TSH. Specifically, as colony size increased, the relative size of regions within the mushroom bodies of the brain decreased in trunk-ants but increased in leaf-ants; those regions play important roles in learning and memory. Our findings suggest that workers specialized in defence may have reduced learning abilities relative to leaf-ants; these inferences remain to be tested. In societies with monomorphic workers, brain polymorphism enhanced by group size could be a mechanism by which division of labour is achieved.