Ant soldiers don't need big brains

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E. burchellii with larvae of a raided wasp nest. Credit: Geoff Gallice, CC BY 2.0, https://www.flickr.com/people/11014423@N07

Army ant (*Eciton*) soldiers are bigger but do not have larger brains than other workers within the same colony that fulfill more complex tasks, according to a study published in the open access journal *BMC Zoology*. A collaborative team of researchers led by Drexel University in

Philadelphia, US and German colleagues suggests that because the very specific and limited tasks soldiers fulfill place limited cognitive demands on them, investment in the development of brain tissue is also limited.

Prof. Sean O'Donnell, lead author of the study said: "To compare different types of ant castes—soldiers and other workers—we took advantage of the dramatically distinct soldier class of workers in *Eciton* army ant colonies. Soldiers are morphologically distinct—they are bigger than their nest mates—but also behaviorally distinct: they have a simpler behavioral repertoire. Our findings support the idea that the simple behaviors of soldiers allow for reduced investment in brain development."

Ants are eusocial insects and as such variations in individual abilities are organized based on what benefits the colony as a whole rather than the individual. The authors hypothesized that this colony-level selection may lead to different brain sizes in different castes of ant workers, depending on the cognitive demands placed on them by the function they perform within the colony.

The authors compared total brain size against body size for 109 army ant workers and 39 soldiers across eight species and subspecies of *Eciton*. Examining the ants' antennal lobes, which receive olfactory information, and their mushroom bodies, higher brain centers involved in learning and memory, the authors also investigated if brain architecture differed between workers and soldiers. They found that although soldiers were larger than workers, their total brain size was not significantly different. They also had relatively smaller antennal lobes and smaller mushroom bodies.

The findings suggest that as brain tissue development and maintenance is costly to a single organism as well as to the ants' colonies as a whole, natural selection at the colony level favors reduced investment in brain

tissue in soldiers which deal with fewer cognitive demands than other workers. The authors also found that soldiers have relatively large muscles attached to their mandibles—which are used in fighting off attackers—which suggests that brain investment may trade off against muscle development in different kinds of ant workers.

Prof. O'Donnell said: "We believe this is the first study to explore the possibility of reduced brain investment in social group members, with the evolutionary advantages accruing at the colony level, despite potential cognitive costs to the individuals. Most previous studies of this kind compared different species, or explored which factors could favor increased brain investment at the individual level. Our study explores how a reduction in behavioral capacity, and an associated reduction in brain investment in individuals, could benefit social groups as a whole."

More information: Sean O'Donnell et al, Brain investment under colony-level selection: soldier specialization in Eciton army ants (Formicidae: Dorylinae), *BMC Zoology* (2018). DOI: 10.1186/s40850-018-0028-3

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