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Evolution of bigger helpers in ants: stronger head and prothorax

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Ants are a remarkable example of phenotypic plasticity at the service of behavior, exhibiting morphological castes that are well-adapted to specific tasks within the colony. Much of caste variation in ants involves allometric differences in structures that have high functional significance. For example, the large head capsule of major workers and soldiers accommodates massive mandibular muscles that, together with mandibles having specialized shapes, convert the head into a powerful tool. It is well known that head size scales with positive allometry relative to body size: bigger helpers have proportionally much larger heads, thus giving more power to the mandibles. A recent morphological analysis (http://dx.doi.org/10.7554/eLife.01539) has shown that an enlarged prothorax is also important in the use of the head-as-tool, since it houses specialized musculature that supports the head and controls its movements. A corollary of this functional coupling is that the prothorax should scale in size following head size rather than overall body size. To test this prediction we analyzed the static allometry between the head, pronotum and body size in various ant species, belonging to several genera and subfamilies, having workers highly variable in size or discrete soldiers. We also performed comparative anatomy of the internal skeletomuscular system of the prothorax. Our results show that the prothorax scales as predicted, and that its specialized function is further enhanced by unique muscle-bearing invaginations of the cuticle present only in the bigger helpers. We discuss the impact that these types of allometries have in the integration of form and function in the context of sociality, and in the evolution of novel phenotypic diversity.