



From random to coordinated collective motion in termites?

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Social insects are known to shift from random to coordinated collective motion in different scenarios. When moving from place to place, colonies can efficiently coordinate movement by establishing an array of interconnected pathways. In termites, one mechanism for building such trails, the pheromone laying, has been intensively investigated by researchers. However, despite research efforts to link chemical signaling to movement patterns, how group structure influences the emergence and maintenance of self-organized trails, is still unclear. Here, we present an empirical framework for investigating the underlying mechanisms of collective motion in termites. Specifically, we ask whether termite colonies exhibit movement rules, and modulate behaviour based on group structure and interactions among individuals. We focus on two measurable parameters of group morphology: density (number of individuals per area), and composition (worker/soldier caste ratio). By combining high-resolution videos with automated tracking methods, we extract trajectories and access the number of encounters and interactions for each individual in a group. The analysis of group-level order parameters (e.g. polarization, rotation, and instantaneous alignment) reveal non-linear properties in terms of organization, indicating that termites are sensitive to changes in group structure. As such, individuals in a group modulate their motion by adjusting parameters such as angular velocity, speed and turn rate. This is evidence that termites switch between behavioural states, from random to coordinated collective motion depending on group morphology, and we are investigating this further. The dynamical structure of groups may have significant impact on individual behaviour, and thus, on collective outcomes such as self-organized trails. Also, we argue that the multistability and transitional behaviour we observe, reinforces the view of termites as excellent models for studying collective behaviour.