



## **Social insects modulate their behaviour according to caste and spatial context**

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Colonies of social insects typically exhibit a marked division of labour, in which work is divided into different tasks which are each carried out by specialised worker castes. A hallmark of division of labour is that the colony population is spatially segregated according to caste. However, the individual-level behavioural processes that govern the spatial sorting of social insect workers according to caste remain poorly understood. To address this we used automated video-tracking to collect the within-nest spatial trajectories of 29931 workers from four species of social insect, namely the honey bee *Apis mellifera* and the ants *Lasius niger*, *Leptothorax acervorum*, and *Temnothorax nylanderii*. We present a novel analytical framework in which these trajectories are combined into a bipartite network consisting of two types of nodes – individuals and spatial locations – which are connected by edges representing the visits of a given individual to a particular location. We demonstrate that these networks are naturally segregated into several partitions, each representing a ‘spatial caste’. Further, we show that colonies of ants and honey bees exhibit qualitative differences in the spatial organisation these castes. First, whilst the honey bee castes were clearly delineated, the ant castes exhibited considerable overlap. Second, whilst the ants and honey bees share a common caste set (nurses, generalists, and foragers), ant colonies also exhibit an additional caste – intermediates – occupying a unique position at the spatial and topological intersection of the other castes. Despite these between-species differences we show that all species exhibit a common behavioural pattern, in which individuals differentially adjust their mobility according to their location and their caste identity. This suggests that spatial segregation within complex animal societies may originate from a simple context-dependent movement rule.