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Title: The persistence and fidelity of behavioral symbioses

Abstract: The specificity of interspecies partnerships is posited to arise from sensory tuning to host-derived cues, a model supported by studies of neural function in host-specific model species, but one that is challenging to reconcile with pervasive host switching across many specialist clades. We examined the chemosensory basis of symbiotic interactions between a myrmecophile rove beetle and its single, natural host ant species. We show that host cues trigger analogous behaviors in both the ant and myrmecophile. Cuticular hydrocarbons—the ant's nestmate recognition pheromones—elicit partner recognition in the myrmecophile and execution of ant grooming behavior that achieves chemical mimicry. The myrmecophile also follows host trail pheromones, permitting inter-colony dispersal. Remarkably, however, the myrmecophile performs these same adaptive behaviors with non-host ants separated by up to ~100-million years and shows no preference to interact with its natural host over non-host ant species. Experimentally validated agent-based modelling supports a scenario in which specificity is enforced by negative fitness interactions with alternative hosts rather than via sensory tuning. Latent compatibilities with alternative hosts may be widespread, contributing to host switching and the persistence of seemingly specialized lineages over deep time.