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The larval pheromone beta-ocimene regulates foraging in honeybees

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Social insects communicate in part using pheromones that are capable of eliciting behavioral and physiological responses across a broad spectrum of time scales. Honeybee larval pheromones have emerged as a robust system for deciphering the behavioral consequences of nuanced chemical communication. Brood ester pheromone, which is comprised of 10 esters, suppresses worker ovary development, modulates the behavioral transition from nursing to foraging, and regulates the level of pollen foraging by the colony. However, it is still not clear how workers, especially foragers, detect these brood pheromones. The recently discovered larval pheromone E-beta-ocimene induces long-term physiological effects similar to those produced by brood ester pheromones. Because beta-ocimene is a volatile compound, it is hypothesized that worker bees throughout the hive can directly assess beta-ocimene and modulate their behavior accordingly. In this study, we tested the hypothesis that bees could directly assess volatile larval pheromones by investigating the role that beta-ocimene plays in the regulation of foraging activity. Four naturally-foraging honeybee colonies were exposed to a one-hour pulse of either synthetic beta-ocimene or a paraffin oil control, and the number of returning pollen or nectar foragers was recorded once an hour thereafter. Exposure to synthetic beta-ocimene significantly increased overall foraging activity - but not pollen foraging - thus verifying that honeybee larvae can communicate directly with foragers via volatile chemical signals. Further, this study demonstrates the potential for synthetic chemicals in the study of pheromones and raises questions about the relationship between two classes of brood pheromones: beta-ocimene, a lightweight volatile and brood ester pheromone, a complex blend of 10 non-volatile compounds.