2010

Bees do not normally learn to discriminate between odor mixtures with a dominant odor but habituating the bees to the dominant odor greatly improves performance

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Introduction:

•Past work in the Bee Lab has shown that honey bees can discriminate between solutions based on the odor of the components of the solution

•It was found that the bees had a more difficult time discriminating between samples when the concentration of the solutes became more dilute

•The solutions that were tested included both lab created urea solutions and human urine samples because the samples were solutions that already contained many micro-solutes to test against, allowing for the bees to identify differences in the solutions based on the dilute quantities of markers.

•We hypothesized that the major component of the urea in the solutions was hindering the bees' ability to discriminate between the minor components of the solutions

•My specific question was:

1) Can habituating bees to the dominant odor in a complex mixture improve their ability to learn to detect minor odorants in that mixture?

•**Methods:**

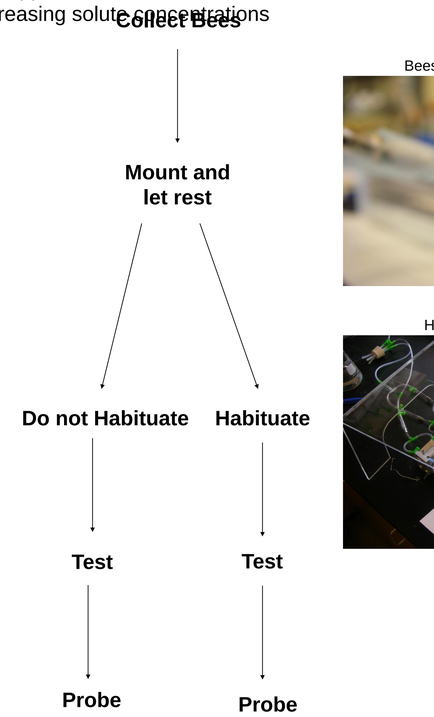
•Bees were collected from two source hives, harnessed, and left to rest

•Testing odors were created from 0.5M urea and varying concentrations of either hexanol or heptanal

•In the control trials, we presented the bees with a pseudo-random order of two different complex odors during eight testing trials, and were then presented with three novel 'probe' odors that contained pure, dilute amounts of the testing odors components

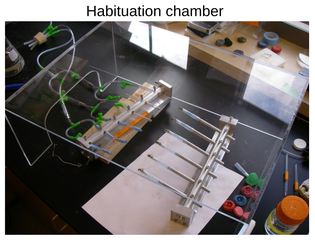
•We then habituated the bees to urea by resting them in an environment saturated with a urea odor, and then tested them in an identical manner to the control trials while constantly applying a background odor of urea

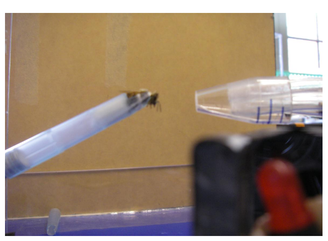
•We applied control and habituation conditions to testing trials and four decreasing solute concentrations



Bees resting before testing

Habituation chamber





Testing with odor and probes

Results and conclusions:

Bees do not normally learn to discriminate between odor mixtures with a dominant odorant. Habituating the bees to the dominant odo

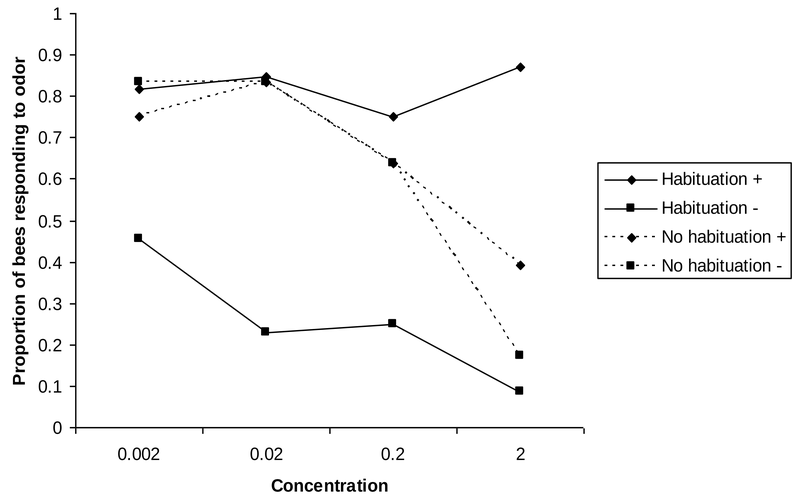


Figure 1. The effects of odorant molarities on the honey bee's ability to discriminate between components of solutions. Solid lines represent the habituated bees' correct responses to the positive (+) odor, and a discrimination error response to the negative (-) odors over a serial dilution, 0.002M-2M, of the solution components. Dashed lines represent the non-habituated testing group.

•Honey bees were incapable of discriminating between two lab created odors under environmental conditions at concentrations of 0.2M and below.

•Honey bees showed a strong level of odor discrimination after habituation to the common urea (major) component of the odors.

•These results show that honey bees can be trained to discriminate between two lab created odors and that habituation to the dominant odor component masks the odor and improves the bees' to ability to discriminate between minor odor components

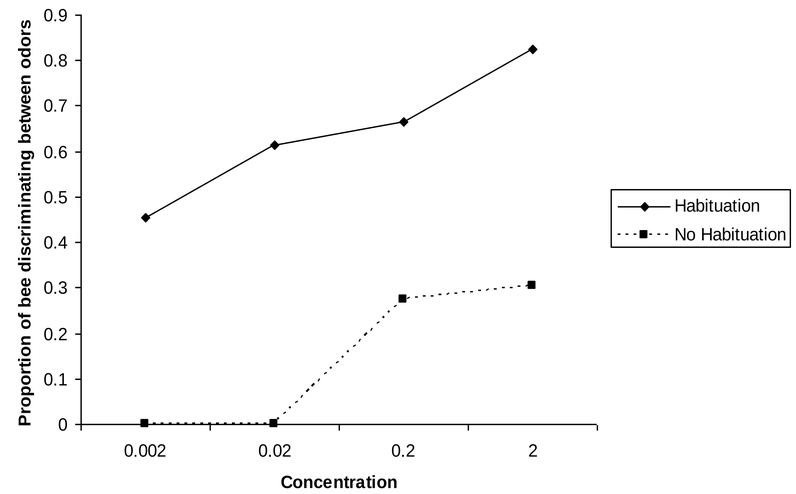


Figure 2. The proportion of honey bees classified as discriminators after odor training. Solid lines represent the proportion of bees that were classified as discriminators, correct response to trials 7 and 8 of testing, and dashed lines represent the non-habituated group.

•As odor concentrations decreased, so did the proportion of discriminating bees in both groups, and the non-habituated group, at the lowest concentrations, had zero discriminators

•The proportion of discriminators decreased with concentration due to an increased level of difficulty of task and that habituation strongly increases the level of discrimination between odor samples

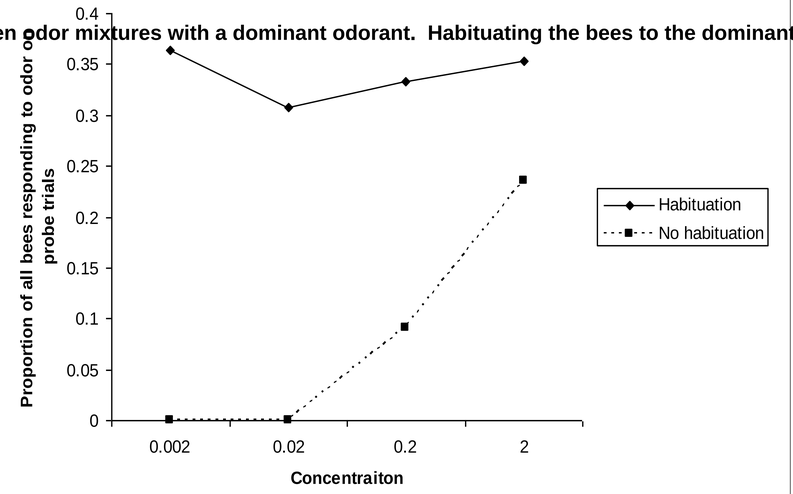


Figure 3. The proportion of honey bees that responded correctly to novel probes after discrimination training. Solid lines represent the proportion of habituated bees that correctly identified the positive component only probe while ignoring the other two probes, and dashed lines represent the non-habituated group's response to the probes.

•With habituation, a steady ~35% of bees could correctly identify the training odor probe across all four concentrations.

•When presented with novel probes, the non-habituated bees did not identify the training odor probe at concentrations lower than 0.2M

•Our results show that bees can in fact be trained to discriminate between odors with micro-solute components, such as urine, more effectively with habituation.

•Previous studies have shown that bees can identify bombs in a manner similar to dogs, and that dogs are capable of discriminating between cancerous and non-cancerous urine samples.

•The similarities between bees' and dogs' capabilities suggests that the honey bee could be used for such tasks as drug screening and cancer identification in urine.

•Bees do not normally learn to discriminate between odor mixtures with a dominant odorant and habituating the bees to the dominant odor greatly improves performance.

Future work:

•Apply the habituation training to urine samples from a mouse model for prostate cancer

•Apply the habituation training to human urine samples to screen for solutes such as cancer markers and drugs

Acknowledgements:

•Thank you to Dr. Sue Hannaford and Dr. Robin Foster for guidance through my research and troubleshooting

•Thank you to the University of Puget Sound for the opportunity to participate in summer research and for my laboratory funding

•Thank you to my lab mates for making my summer exceptionally entertaining

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