Effects of Antennae Alteration on Ant Behavior

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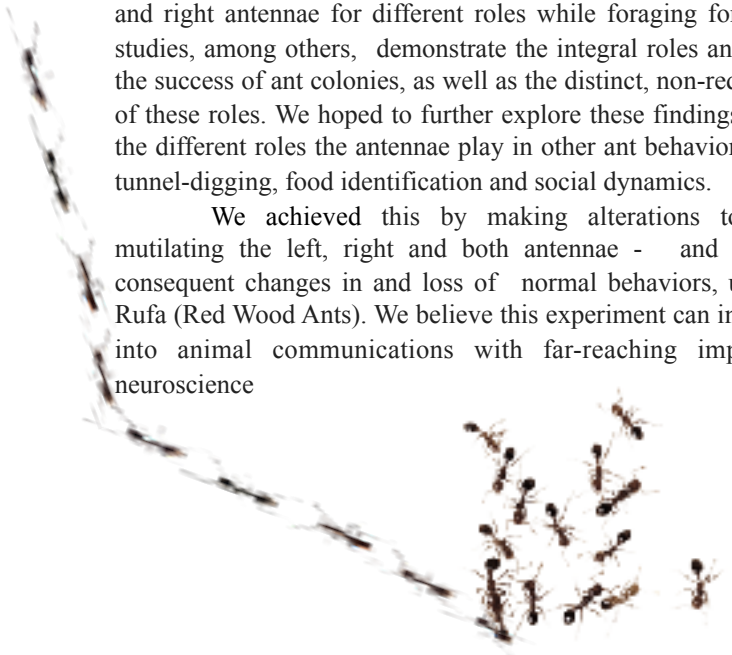
Background/Abstract

Ants are master communicators. They send and receive messages by releasing chemicals (called pheromones) from specific glands, making sounds with different body parts, "dancing" messages, and touching each other with their antennae. These chemical, audial and physical modes of communication allow for complex and cooperative behaviors in colonies. From aphid farming to fungi-breeding, slavery, leaf-weaving and mass invasions, complex ant behaviors take root from effective communication which is rooted in one major body part: the antennae.

Ants use antennae as tools not just in interpersonal communication, but in perceiving the world around them. Researchers discovered decades ago that the loss of antennae equals a loss not only in communication, but in the general functioning of ants individually and collectively. More recent studies have shown that ants use their left and right antennae for different roles while foraging for food,. These studies, among others, demonstrate the integral roles antennae play in the success of ant colonies, as well as the distinct, non-redundant nature of these roles. We hoped to further explore these findings and examine the different roles the antennae play in other ant behaviors, specifically tunnel-digging, food identification and social dynamics.

We achieved this by making alterations to antennae - mutilating the left, right and both antennae - and observing the consequent changes in and loss of normal behaviors, using Formica` Rufa (Red Wood Ants). We believe this experiment can inspire research into animal communications with far-reaching implications for neuroscience



Question

What are the distinct roles do ant antennae play in other ant functions?

Materials/Methods

Materials in **bold**

Antennae Manipulation

- Using **tweezer**, grab 15 **ants** from nest and place them in a **container.** Place container in **freezer** or **ice pack** for about 10 minutes.
- After 10 mins, take out an ant and cut out the desired antenna(e) using a **scalpel**. After surgery, place ant in a separate **jar**
- Repeat process for remaining ants

Experiment

- Fill a **jar** halfway with **sand**
- Set a **timer** for desired time frame
- Place desired **stimulus** in jar. Gently place ants in jar (15 per group)
- Observe
- Repeat process for each experimental group

Groups

Experimental groups: Control, left A. off, Right A. off, Both A. off

Stimuli Sand, jello, sugar, Vinegar, termite nymph

Resources

Robert Frawley, Ph.D., Barbara Noro. Ph.D.

Holldobler, Bert; Wilson, Edward. *Journey to the Ants: A Story of Scientific Exploration*. Cambridge: The Belkap Press of Harvard University Press, 1994. Print.

Journal of Environmental Biology, Rockefeller University

Results

Stimulus	Control	LA (RA off)	RA (LA off)	BA (BA off)
Sand tunnels	Formed within 20 mins	Formed at slower rate and with less complexity than the control group	No digging attempted	No digging attempted
Jello + Sand	Consumed + covered jello with sand	Consumed; no sand coverage	Slightly consumed. Partial sand coverage	Untouched
Sugar grains (added after 5 mins)	Consumed and carried in mouths	Consumed and carried in mouths	Consumed	Untouched
Vinegar on cotton ball (added after 10 mins)	Detected and avoided completely	Detected. Avoided by majority	Detected. Avoided by majority	Detected only after physical touch
Termite nymph (added towards end of experiment)	Detected within seconds; carried	Detected within seconds; carried	Nymph killed/left in the sand; undetected	Ignored, undetected
Overall Behavior	Lively, active, energetic	Slightly active, isolated, perceived and reacted to sound, regardless of proximity to sound source	Inactive, lay in clumps; perceived and reacted to sound only when in very close proximity to sound source	Very inactive. lay around still; perceived and reacted to sound only when in very close proximity to sound source

Discussion/Future Directions

In the absence of the left antenna, basic physiological functions were affected. Behaviors such as tunnel digging, sound perception, spatial awareness and identification were lacking. The group with the left antennae intact behaved most similarly to the control group. Without the right antenna, social functions, including trophallaxis and unity, were absent. A probable conclusion is that the left antenna serves as a physiological guide to the ant, while the right antenna enables social and interpersonal functions. It is also possible that the left antenna plays a more dominant role, while the right antenna serves as its helper, similar to right-handedness in humans. Further research focused on interchanging the left and right antennae, such as by physically cross-linking them, and studying other functions over extended periods, would be helpful in testing this conclusion.