Insect Behavior - Advanced

Douglas Wilkin, Ph.D.
Jennifer Blanchette

AUTHORS
Douglas Wilkin, Ph.D.
Jennifer Blanchette

Printed: February 5, 2024 (PST)

Insect Behavior

Insects occasionally exhibit unique social structures and are capable of learning new behaviors.

Insect Behavior - Advanced

[Figure1]

Teamwork?

Yes, many insects, especially bees and ants, work as a team for all to survive. Each individual has a specific job and relies on other individuals for survival. Teamwork is a type of behavior.

Insect Behavior

What exactly is behavior? It is defined as the way that organisms respond to their environment and to internal signals. In addition to many basic behaviors that are shared by other invertebrates, such as mating, there are some insect species that are capable of more advanced forms of interaction with each other and with their environments. There are two types of behavior that can be observed in organisms: **innate behavior** and **learned behavior.** Innate behavior is genetically encoded. Flight and mating habits are considered innate behaviors. You have probably seen a clear example of innate insect behavior called the dorsal light reaction. Flying insects will sense the direction of light coming from the sun and fly in a way that keeps the sun overhead, or on their dorsal side. This is a means for the insect to maintain a flight plan that is parallel to the ground. You may have witnessed that this innate behavior is not so helpful when a moth encounters an artificial light source and flies in continuous circles around it to keep the light on its dorsal surface. At times, the moth is not able to fly away from that light source and, in essence, becomes trapped. Another insect behavior that you have probably experienced firsthand is sound production. Some insects produce sounds in order to communicate. An example is the chirping of crickets that often lulls us to sleep on warm summer nights.

Learned behaviors are those that are not encoded genetically and are not present in the organism at birth. They are obtained through life experiences, and they can change or improve over time. Learned behaviors require acute sensing of environmental signals and a fairly complicated network of nerve cell connections for transmitting those signals in order to process the information and modify or initiate a behavior. Insects are capable of this level of behavior. In order to forage for food and return to the same food source repeatedly, they use a type of learning called **associative learning.** Associative learning is when separate ideas or environmental stimuli are connected to each other. For example, the location of a food source can be associated with a series of visual cues seen on the way to the source. In this way, the organism learns that if it follows a path that includes all of those visual cues, it will again find the food source. There are examples of this type of learning that can be tested experimentally. For example, honeybees can be taught to obtain their food from a particular source based on color cues, even when the location of that source changes. They can learn that their food (sugar water) is located on a yellow dish next to a blue dish containing only water. If the dish positions are switched, the bees remember which color has the food, and they seek that dish.

There are several groups of insects that have evolved complex social networks that involve elaborate patterns of communication between individuals within the community. These species are called social insects, and we will examine their behavior in the next section.

Social Insects and Communication

Insects and other organisms that live together in well-organized and tightly integrated colonies are called **eusocial** animals. Eusocial insects include species of ants, termites, bees, and wasps. Some colonies can include millions of individual animals. These are two of the major features of eusocial insects:

- Division of reproductive labor.

- Cooperative care of the young members of the colony.

Social ants are a good example of the division of reproductive labor. The individual ants within a colony divide up into three major groups:

- Fertile females (queens).
- Infertile (sterile) females (workers).
- Fertile males (drones).

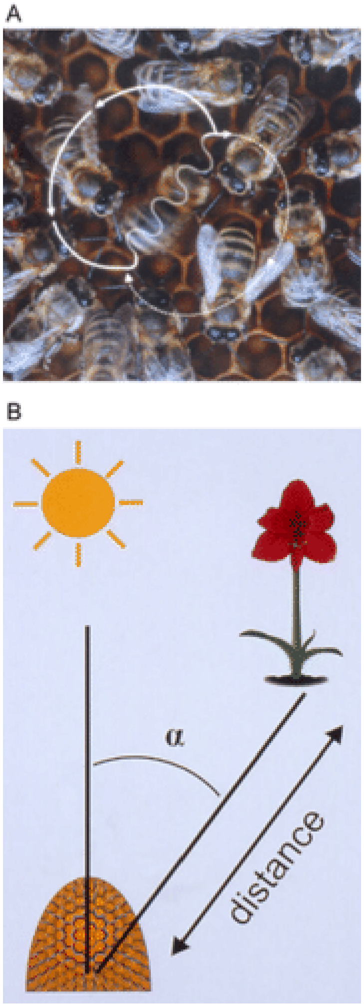
Fertile males and queens carry out the reproductive activities of the colony, while workers focus on obtaining food as well as building and maintaining the nest or hive. In some social insect colonies there are other specialized individuals; nurses, for example, feed and care for young larvae. Often times, some individuals in a colony will form a defensive army with the main purpose of defending the nest.

[Figure2]

A Termite Nest. This cathedral-like structure is the nest of a huge colony of termites in Australia. In fact, it is the world's largest known termite nest. It towers 7.5 meters (25 feet) above the ground and houses millions of termites.

Communication between members of a colony can take several different forms. Ants generally communicate using **pheromones.** Pheromones are hormones that are released by one individual to be sensed and responded to by another individual. You may have noticed how a group of ants making their way to a crumb on the ground will generally travel lined up one in front of the other. This is because they are sensing and following a trail of pheromones that was laid down by an earlier ant that discovered the crumb. On its way back to the nest, this little pioneer (called a forager) left a trail of pheromone for other colony members to follow.

Honeybees have evolved a fascinating form of communication using body movement. These insects perform an elaborate dance called the "waggle dance" to tell other colony members where to find a source of food. The angle of the dance indicates the particular direction of the food source relative to the sun, and the length of the dance correlates with how far away the food is, as shown in **Figure**below**.** This is considered a form of abstract symbol communication, meaning that they use a behavior to represent information (in this case a location) about something in the environment.



[Figure3]

Bee communication. Some bees can tell each other the location of a food source by performing a "waggle dance." The dance is outlined in this diagram. The angle (alpha) of the "waggle," represented by the wavy section of the bee's path, from the sun indicates the direction of the food source. The length of the "waggle dance" indicates how far away the food source is.

https://www.ck12.org/flx/render/embeddedobject/186757

In addition to the ability to learn, some species of social insects have also been shown to teach behaviors to other individuals. An example of this is seen in one ant species where the forager ant (the one who ventures out to find food) will actually take the time to lead a nest-mate to a new food source, in a way teaching the nest-mate how to forage.

Altruism is another feature of many social insects. Altruism is the act of self-sacrifice for the benefit of others. A worker bee, for example, forfeits her own potential for reproduction in order to obtain food and provide shelter for the benefit of the queen bee. This allows the queen bee to focus on the reproduction of her genetic material at the cost of the worker bee reproducing her own genetic material. This complex phenomenon is a favorite topic of study among philosophers and sociologists, and there are a number of different theories on the evolutionary advantage of altruism that you can read about in the *Animal Behavior: Evolution (Advanced)* concept. What do you think might be the evolutionary driving force behind altruism?

KQED: Ants: The Invisible Majority

Most of us think ants are just pests. But not Brian Fisher. Known as “The Ant Guy,” he's on a mission to show the world just how important and amazing these little creatures are. In the process, he hopes to catalog all of the world's 30,000 ant species before they become casualties of habitat loss.

KQED: Ladybugs: A Population of Millions

Ladybugs, also known as ladybird beetles, have a life cycle of four to six weeks. In one year, as many as six generations of ladybird beetles may hatch. In the spring, each adult female lays up to 300 eggs in small clusters on plants where aphids are present. After a week the wingless larvae hatch. Both the ladybird beetle larvae and adults are active predators, eating only aphids, scales, mites, and other plant-eating insects. The ladybugs live on the vegetation where their prey is found, which includes roses, oleander, milkweed, and broccoli. Adult ladybugs don't taste very good. A bird careless enough to try to eat one will not swallow it.

By late May to early June, when the larvae have depleted their food supply, the adults migrate to the mountains. There, they eat mainly pollen. The ladybugs gain fat from eating the pollen, and this tides them over during their nine-month hibernation. Thousands of adults hibernate overwinter in tight clusters, called aggregates, under fallen leaves and ground litter near streams. In the clear, warmer days of early spring, the ladybugs break up the aggregates and begin several days of mating.

Summary

- There are two types of behavior that can be observed in organisms: innate and learned.
- Insects are capable of learned behavior.
- Two of the major features of eusocial insects are division of reproductive labor and cooperative care of the young members of the colony.
- Communication between members of a colony can take several different forms such as "dances" or pheromones.
- In addition to the ability to learn, some species of social insects have also been shown to teach each other various behaviors.

Review

1. In every day life, we often see insects circling a light source at night. What is this behavior called, and why has it evolved in insects?
2. Bees, ants, and termites are all considered eusocial animals. What characteristics distinguish eusocial insects?
3. How do species such as ants and bees communicate with each other within their complex social structure?

1.0 REFERENCES

Image	Attributions
	**Credit:** balouriarajesh **Source:** https://pixabay.com/photos/beehive-honeybees-bee-beekeeper-3960986/ **License:** Pixabay License
	**Credit:** Essowoe **Source:** https://commons.wikimedia.org/wiki/File:Termiti%C3%A8re_(9).jpg **License:** CC0
	**Credit:** Figure design: J. Tautz and M. Kleinhenz, Beegroup Würzburg **Source:** http://commons.wikimedia.org/wiki/File:Waggle_dance.png **License:** CC BY 2.5