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Visual Communication in Insects

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The term "communication" is frequently used by ethologists to refer to "an action or situation on the part of one organism that modifies the behavior of another organism in an adaptive manner." Insects may send a communication signal by doing something (e.g. make a noise, release a chemical, or flash a light) or the signal may simply be an inherent part of the insect's physical makeup (e.g. wing pattern, body color, or surface chemistry). In either situation, the signal needs to cause a behavioral shift in order for a person to notice it. Insects use touch, smell, sound, and sight to communicate. Communication through sight is referred to as visual communication. In the following article visual communication would be discussed in detail.

Visual Communication

Many insects use visual cues to communicate. Some insects use bright colors, eyespots, or other distinctive patterns to scare away predators, to advertise their ability to sting, or to mimic the appearance of another unpalatable species. Other insects use dance-like body movements to attract a mate or to communicate with nestmates.

Only when they are visible during the day are the majority of these signals useful. But other insects, like fireflies, can produce their own light and employ visible visual cues at night. Eyespots and color patterns are examples of passive signals that might act as "free advertising." Since they are an essential component of the integument, displaying these messages on an individual insect has little or no metabolic cost. It may be prudent to hide these signals from a potential predator, so some insects have a way to conceal their message when necessary.

Although producing active messages like body movements and light flashes is more expensive, but they can be withheld from use at inappropriate times. In fireflies, for example, pulses of light are used in a courtship dialogue between a male (usually flying) and a female (usually perched in the vegetation). Numerous insects can see ultraviolet light, unlike humans. For instance, the dorsal wing surface of female cabbage butterflies is covered in scales that reflect ultraviolet light. A "flashing female" may attract several males who engage in aerial courtship displays.

Photoreceptors

The primary visual organs of most insects are a pair of compound eyes, which are present in almost all adults, and numerous immatures of the ametabolous and hemimetabolous orders. Compound eyes, as its name implies, are made up of numerous comparable, densely packed facets, or ommatidia, which serve as both the structural and functional components of vision. Ommatidia count varies greatly between species, with some worker ants having fewer than six and others, like some dragonflies, having more than 25,000. Each ommatidium on the majority of diurnal insects is surrounded by pigment cells. Insects that are active at night and during the day have pigment cells that do not entirely isolate each facet.

In comparison to vertebrates, insects have significantly poorer visual acuity because they are unable to construct a true (i.e., focused) image of their surroundings. On the other hand, their ability to sense movement, by tracking objects from ommatidium to ommatidium, is superior to most other animals. Most insects, unlike people, are able to tell the difference between polarised and unpolarized light. They are able to use the location of the sun in the sky as a cue for orientation even on gloomy or overcast days.

Insects' spectral sensitivity range is tilted toward shorter wavelengths as compared to humans (higher frequencies). Insects can, therefore "see" UV light, which is undetectable to humans. In contrast, insects are unable to detect wavelengths that humans can see near the red end of the spectrum. However, true color vision entails more than just a broad spectral sensitivity range. Few insects—most notably bees and butterflies—have "full" color vision, but the majority of insects have just a limited capacity to distinguish between different colors of light.

Functions of Visual communication

1). Aggregation and Dispersion: A nice illustration of complicated behavior that is visually mediated is territoriality in dragonflies. The bulging eyes of the Odonata are arguably their most distinctive characteristic. They permit a degree of motion perception that is quite exceptional for fixed-focus eyes (for some, up to 40 yards away), in combination with a head that can be easily rotated upon a slender neck. In addition, the antennae, so prominent in most insects, are minuscule, and their removal appears to make no difference in navigation or prey capture. These observations might indicate that dragonflies are among the few insects whose sight predominates over other senses in a significant way.

2). Alarm: In marked contrast with auditory and chemical communication systems, specialized visual alarm systems have rarely evolved in insects. The fact that the majority of predators heavily rely on their visual sense when hunting may be one explanation for this. It is extremely challenging for potential prey to visually alert its friends without also drawing attention to itself to the predator. Thus, rather than being provided by specialist systems, the most frequent visual cues that prompt vigilance, alarm, and flight tend to be produced by the very activities of flight.

3). Sexual signals: Lepidoptera, with their wings of decorative colors and patterns, are primarily visual communicators, making little use of odours and touch in their sexual behavior. The extremes are most easily recognized by differences in the behavior of males. The "chemical type" searches for the female in a slow zigzag flight upwind by following the scent. The "visual type" searches for the woman and moves swiftly in her direction. There are two phases to the courtship process for the common orange queen butterfly in southern Florida: an airborne phase and a ground phase. Males are initially drawn to females visually during the airborne phase through a combination of movement, color, and shape; this attraction is extremely universal, and males frequently incorrectly chase inappropriate objects like falling leaves. However, a chemically mediated phase starts after the male overtakes the female.

Advantages of Visual communication

1. Effective over long distances
2. Can be used while moving
3. Fast
4. Effective in all directions (independent of wind)
5. Passive signals don't require any energy to operate.

Disadvantages of Visual communication

1. Requires a clear line of sight
2. Predators may decipher visual messages.
3. Useful only in daylight (in fireflies, only at night)
4. The production of active signals may be metabolically "expensive"