Thermoception: How We Sense the Invisible World

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Thermoception or thermoreception is the sense by which an organism perceives temperatures. The details of how temperature receptors work are still being investigated. Ciliopathy is associated with decreased ability to sense heat, thus cilia may aid in the process. Transient receptor potential channels (TRP channels) are believed to play a role in many species in sensation of hot, cold, and pain. Mammals have at least two types of sensor: those that detect heat (i.e., temperatures above body temperature) and those that detect cold (i.e. temperatures below body temperature).

A particularly specialized form of thermoception is used by Crotalinae (pit viper) and Boidae (boa) snakes, which can effectively see the infrared radiation emitted by hot objects. The snakes' face has a pair of holes, or pits, lined with temperature sensors. The sensors indirectly detect infrared radiation by its heating effect on the skin inside the pit. They can work out which part of the pit is hottest, and therefore the direction of the heat source, which could be a warm-blooded prey animal. By combining information from both pits, the snake can also estimate the distance of the object.

The Common vampire bat has specialized infrared sensors in its nose-leaf. Vampire bats are the only mammals that feed exclusively on blood. The infrared sense enables Desmodus to localize homeothermic (warm-blooded) animals (cattle, horses, wild mammals) within a range of about 10 to 15 cm. This infrared perception is possibly used in detecting regions of maximal blood flow on targeted prey.

Other animals with specialized heat detectors are forest fire seeking beetles (Melanophila acuminata), which lay their eggs in conifers freshly killed by forest fires. Darkly pigmented butterflies Pachliopta aristolochiae and Troides rhadamathus use specialized heat detectors to avoid damage while basking. The blood sucking bugs Triatoma infestans may also have a specialised thermoception organ.

In humans, temperature sensation from thermoreceptors enters the spinal cord along the axons of Lissauer's tract that synapse on second order neurons in grey matter of the dorsal horn. The axons of these second order neurons then decussate, joining the spinothalamic tract as they ascend to neurons in the ventral posterolateral nucleus of the thalamus.