# Insects tune in to the speed of their world

Although people can augment their eyesight with prescription glasses for special tasks, such as driving or working at a computer, insects must perform their day-to-day work with only their natural optics. Fortunately, however, insects come fitted with visual systems that are well suited to their particular lifestyles, a new study demonstrates.

Insects depend on their ability to detect motion, either their own or that of an object speeding by them, to fly successfully and to detect fellow insects. Hawkmoths, the so-called hummingbirds of the insect world, and other bugs that frequently hover in the air must track slow motion well. Insects like butterflies and bumblebees tend to dart around quickly and need to monitor fast movement accurately.

Scientists tested the sensitivity of a variety of insects to patterns moving at different rates. Nonhovering insects, on average, responded most successfully to patterns that moved 5 to 10 times faster than the speed at which hovering insects process patterns best.

In insects, as in people, the neural mechanisms for motion detection are matched as closely as possible to motion experienced during their normal activities, assert David C. O'Carroll of the University of Cambridge in England and his colleagues in the July 4 NATURE.

Moreover, the optimally processed speed "varies over an enormous range" among species, says O'Carroll. Hawkmoths respond best to patterns that repeat at a frequency of 1 to 2 hertz (Hz), while bumblebees are most sensitive to frequencies of 25 Hz. Insects can generally detect fast-moving objects more clearly than slow ones, he notes.

While not surprising, the findings "give us another handle on eyes and visual systems" by showing that what an insect sees depends on how it moves, says Mandyam Srinivasan of the Australian National University in Canberra. The authors use an elegant approach for depicting the sensitivity of insects to motion, he adds.

The investigators studied two species each of bees, flies, butterflies, hoverflies, and hawkmoths. They measured the firing rates of motion-sensitive neurons in the insects' brains while pictures of black, white, and gray stripes moved by the bugs. Previous research on flies suggests that these neurons code motion information during flight and help stabilize the insect. Mutant flies that lack these neurons can't fly.

By presenting the insects with patterns of fine and broad stripes at slow and fast speeds, O'Carroll's group tested the insects' responses to both different temporal frequencies—the rate at which each stripe passes by—and various spatial frequencies—the number of stripes in a pattern. Insects that could see a fine pattern of stripes were able to detect a wider array of slow-moving objects, the study shows.

"When you plot temporal frequency against spatial frequency, you can see [the] optimum velocity for the neuron," O'Carroll explains.

The hoverflies stood out from their eight colleagues. With their very large eyes, they detected fine stripes much more readily than the other insects and were unusually sensitive to both fast- and slow-moving patterns. Most insects can't afford to carry around such big specs. However, these flies require them because they hover while watching out for females and possible invaders, then dart quickly after them. — *T. Adler*

Agricultural Research Service/USDA

*Honeybees are well equipped to detect fast-moving objects. So stand still or move slowly if you don't want them to notice you.*

# Brain scans show inner side of stuttering

People who stutter often come to dread talking to others because of the embarrassing disruptions that break up their speech. These include repetitions of syllables at the start of some words and prolonging of the initial sound in many others. Yet in a fascinating and poorly understood twist, stuttering often vanishes temporarily when the process of speaking is somehow altered, such as by reading aloud in unison with a group, singing, or whispering.

The curious curative powers of group reading have now given scientists an opening through which, with the help of brain-scanning technology, they have glimpsed the cerebral foundations of this condition.

"Stuttering is a disorder affecting the multiple neural systems used for speaking," contends a team of researchers directed by Peter T. Fox, a neuroscientist at the University of Texas Health Science Center at San Antonio.

Most prominently, stuttering induces widespread hyperactivity in motor areas throughout the brain, particularly in the right hemisphere, Fox and his coworkers assert. The cerebellum, a structure at the base of the brain, shows especially strong activity during stuttering, they note.

In contrast, stuttering is associated with the nearly complete shutdown of activity in interconnected parts of the brain's outer layer, or cortex, that are thought to regulate the conscious monitoring of one's own speech, the investigators contend.

Related cortical areas implicated in the ability to string words together fluently also remained unusually inactive during stuttering, they report in the July 11 NATURE.

This particular mix of excessive and insufficient brain activity largely cleared up when stutterers spoke fluently as they participated in a group reading of a written passage.

Fox's team studied 10 men, ages 21 to 46, who had stuttered since childhood, as well as 10 men in approximately the same age range who had never exhibited a speech or language disorder.

Positron emission tomography (PET) scanners measured changes in brain activity, indicated by alterations in blood flow, on three occasions—as each volunteer took a solo turn reading a paragraph aloud, during a group reading of a paragraph, and while the men rested with their eyes closed.

Each stutterer displayed his usual speech problems during solo reading but spoke flawlessly while taking part in a group reading.

All of the stutterers exhibited a remarkably consistent pattern of rises and falls in brain activity as they read the paragraph alone, the researchers maintain. This consistency occurred despite a wide range in the severity of the participants' stuttering. The frequency with which each man stuttered also varied widely throughout the course of a day.

The new PET findings lend support to several theories about what causes stuttering, Fox and his colleagues hold. For instance, some researchers speculate that hyperactivity of the brain's right hemisphere disturbs speech production in the left hemisphere. Others suspect that stuttering reflects hyperactivity in specific motor structures that facilitate speech sounds.

Several alternative theories of stuttering posit primary disturbances in either auditory or speech production areas of the brain.

"Current theories of stuttering each emphasize one or another individual component of what we believe to be a dysfunctional [brain] system or systems," the investigators argue. "Our results strongly indicate the need for a unifying theory of sufficient scope to accommodate the full complexity of the observed actions and interactions of the neural systems." — *B. Bower*