Dealing with the unexpected

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To regain balance from an unexpected slip on the ice can require an abundance of rapid movement, but conscious thought isn't part of the equation.

Or when eating or talking over dinner, no one thinks about altering his breathing even if the food is hotter than expected.

Life is full of unexpected interruptions to rhythmic behaviors that require the flexibility to make subtle to dramatic adjustments, says Hillel Chiel, professor of biology at Case Western Reserve University. And we just do them.

But, we don't know how we deal with the unexpected.

Chiel and Peter Thomas, assistant professor of mathematics in the College of Arts and Sciences, will try to learn how we and, for that matter, all animals rapidly and robustly adjust rhythmic behaviors.

The National Science Foundation gave the researchers a $500,000 grant to make progress understanding this mystery.

The ability to make instant adjustments is coveted. Rescue robots built with this flexibility could avoid becoming trapped while crawling through collapsed mines or buildings. And, while mind-controlled prosthetics would be a boon to the paralyzed, the ability of the prosthetics to adjust to real world interruptions without being prodded by thoughts would make them even better.

Chiel and Thomas won't start by investigating humans but the lowly sea slug and how it adjusts its eating to changes in food.

"One of the beauties of the sea slug is it has only a few dozen cells in the brain generating rhythmic activity, combining robustness and flexibility," Thomas said.

The researchers and graduate student Kendrick Shaw will use ideas from dynamical systems theory that were first developed to explain the movement of planets to build mathematical models to explain how the slug can rapidly adjust as it tries to swallow seaweed, which varies in shape and toughness from bite to bite.

Planetary movements, once thought mysterious, obey Newton's laws of motion. Dynamical systems theory was developed to predict how a system will move -- for example, the planets -- given rules governing the system's rate of change. If successful, the researchers will develop "laws of motion" describing how patterns of activity in the nervous system of the slug change over time.

The results of their work will help us understand how animals and ultimately humans can quickly cope when the unexpected happens, and help create artificial devices that may be better at expecting the unexpected.

Provided by Case Western Reserve University