Hormone alters electric fish's signal-canceling trick

August 10 2023, by Talia Ogliore

African fish called mormyrids communicate using pulses of electricity. Credit: Tsunehiko Kohashi

During the rainy breeding season, the underwater "conversation" among

electric fish changes. Fish revved up to make a match broadcast slightly different signals to advertise their presence and identify compatible mates.

New research from Washington University in St. Louis shows that the hormone testosterone—which naturally triggers male electric fish to elongate the electric pulses they send out during the breeding season—also alters a system in the fish's brain that enables the fish to ignore its own electric signals. The study by biologists Matasaburo Fukutomi and Bruce Carlson in Arts & Sciences is published in *Current Biology*.

All animals, from electric fish to elephants, need to have ways to discriminate between the signals that they share themselves versus signals or stimuli from others. Accurately perceiving and acting upon information from others can make all the difference for reproduction and survival.

The electric fish known as mormyrids send out electric pulses as signals; they also have developed a way to ignore or block their own messages. A system called corollary discharge inhibits the fish's sensory perception for a brief, well-defined period of time after it releases an electric pulse—allowing it to prioritize messages from others, such as potential mates.

Previous studies have shown that testosterone treatment affects electric organs in mormyrids. Adding testosterone to a fish's system causes changes to their behavior by extending the length of the signals that male fish produce. This new research is the first to describe how hormone treatment also alters the fishes' signal perception in a coordinated way.

It all boils down to a straightforward question of timing control, the study co-authors said.

"Testosterone adjusts corollary discharge timing in order to continue ignoring self-generated behavior," said Fukutomi, first author of the new study and a postdoctoral fellow in biology. "Circulating testosterone independently regulates the behavioral output of the electric organ and the corollary discharge that predicts the sensory consequences of that behavior."

Fukutomi and Carlson hope these findings pave the way for future studies on the underlying mechanisms for how testosterone alters electric fishes' behavior and perception. Additional research also could help resolve whether the same mechanisms are involved with both seasonal and evolutionary changes in electric fish. Such research will help bridge the gap between neurons and behavior by revealing how hormones alter the function of neural circuits through their actions on individual cells.

"Early pioneering studies in this system paved the way toward better understanding of corollary discharge across animals, including humans, and this system continues to shed new light on corollary discharge function," said Carlson, a professor of biology.

More information: Matasaburo Fukutomi et al, Hormonal coordination of motor output and internal prediction of sensory consequences in an electric fish, *Current Biology* (2023). DOI: 10.1016/j.cub.2023.06.069

Provided by Washington University in St. Louis