How hairs help fish feel and humans hear

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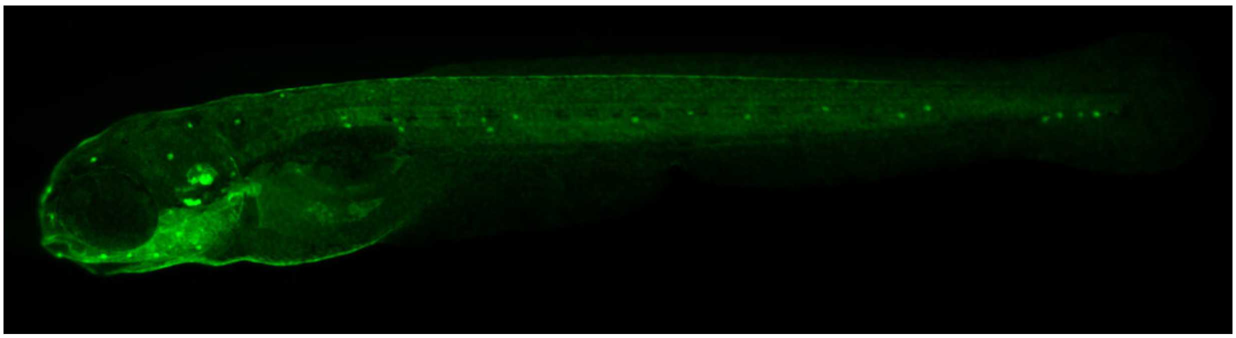


Larval zebrafish that expresses Green Fluorescent Protein in hair cells. Credit: Brian McDermott/CWRU

By discovering how zebrafish use their hair cells to detect distant movement, a team of Case Western Reserve scientists may have found a path to help explain human hearing loss.

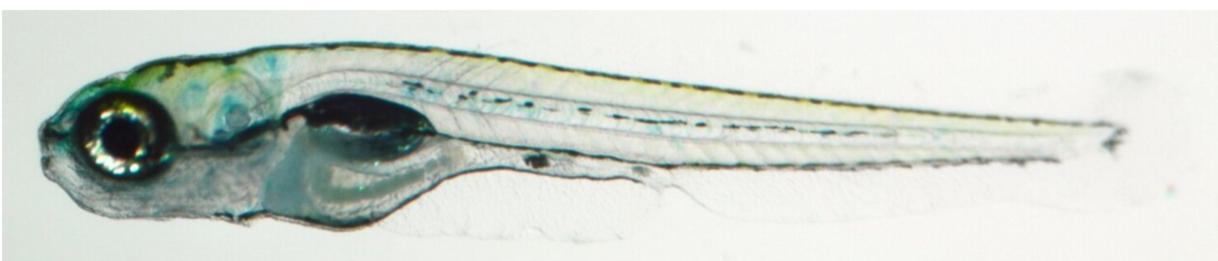
Even though the tiny water creatures and humans would appear to have nothing in common, the structure and function of the hair cells on zebrafish skin are nearly identical to cochlear hair cells found in the human inner ear.

In addition, both the fish and human cell receptors have a type of protein known as an "ion channel," which converts the waves that the cells detect into electrical impulses that carry useful information.

However, in humans, those hair cells are encased in the hardest bone in the body and inaccessible when the ear is responding to sound, said Brian McDermott, an associate professor of otolaryngology at the Case Western Reserve (CWRU) School of Medicine.

"So this research—using zebrafish hair cells which are much more accessible—will definitely help inform our understanding of human hearing and deafness," he said. "We can now say with confidence that fish use their ion channels to escape pursuing predators in ways that are similar to the ways human ears tune to different frequencies."

Otolaryngology focuses on the ear, nose and throat. McDermott, who led the new research recently published online in the journal *Current Biology*, also has secondary appointments in biology, genetics and genomes sciences, and neurosciences at the CWRU College of Arts and Sciences and the School of Medicine.



Larval zebrafish imaged under normal light conditions. Credit: Brian McDermott/CWRU

Understanding mechanotransduction

Scientists had already understood how hair cells functioned physiologically for hearing—but less so at the molecular level. The hair cells are made up of a bundle of movement-sensing rods of increasing heights.

Further, McDermott said the finding also advances our understanding of "the long-sought mechanotransduction (Mec) channel" in living creatures. Mec describes the conversion of mechanical stimuli to electrical signals forwarded to the brain.

McDermott said his research team had a true "eureka moment" when, using the CRISPER-Cas9 gene-editing tool, they discovered that groups of hair cells have asymmetry. That unexpected characteristic allows the hair cells to detect movement from the back of the fish with greater sensitivity than the front.

"This shows that fish have hair cells that are actually *tuned* to sense different water directions," he said. "In humans, our cochleas have hair cells that are similarly tuned to be able to hear different frequencies."

That's why this work could play a role in better understanding hearing—and deafness—in humans, McDermott said.

Contributing authors include CWRU graduate student Kayla Kindig, Assistant Professor of otolaryngology Ruben Stepanyan and National Institutes of Health scientist Katie Kindt.

More information: Kayla Kindig et al, Asymmetric mechanotransduction by hair cells of the zebrafish lateral line, *Current Biology* (2023). DOI: 10.1016/j.cub.2023.02.033

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