

Researchers overturn hypothesis underlying the sensitivity of the mammalian auditory system

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A new study from the University of Colorado Anschutz Medical Campus challenges a decades-old hypothesis on adaptation, a key feature in how sensory cells of the inner ear (hair cells) detect sound.

The paper, out today in *Science Advances*, examines how [hair cells](#) transform [mechanical forces](#) arising from [sound waves](#) into a neural electrical signal, a process called mechano-electric transduction (MET). Hair cells possess an intrinsic ability to fine-tune the sensitivity of the MET process (termed adaptation), which underlies our capacity to detect a wide range of sound intensities and frequencies with extremely high precision. Up until now, 30+ years of research had convinced auditory scientists that the molecules and proteins responsible for adaptation have been figured out. First published in 1987, the prevailing model for how adaptation works asserted that the sound-sensitive "antenna" of the hair cell (called the hair bundle) undergoes a mechanical change during adaptation, such that a decrease in stiffness of the hair bundle caused a decrease in MET sensitivity.

Ancillary experiments conducted over the ensuing decades have suggested that a motor protein, myosin 1c, is required for MET adaptation. Through multiple experiments and a variety of controls, Anschutz researchers determined that this existing hypothesis needs to be reexamined; that although adaptation does require myosin motors, it does not involve a mechanical change in the hair bundle.

Anschutz researchers performed a series of sophisticated experiments to examine the relationship between the mechanical properties of the hair bundle and the electrical response of the hair cell. Using a custom-built high-speed imaging technique, Giusy Caprara, Ph.D., post-doctoral fellow at the University of Colorado School of Medicine and lead author of the study, performed simultaneous electrical recording and imaging of hair cells in a variety of mammalian species at 10,000 frames per second to examine the mechanical changes to the hair bundle during adaptation, an extreme departure from the experiments of 1987 which used photodiodes. "The reason this wasn't uncovered earlier is because there are very few experiments that tested the mechanical properties of the hair bundle," says Anthony Peng, Ph.D., supervising author and assistant professor of physiology and biophysics at the University of Colorado School of Medicine. "Technology drove and made this discovery possible."

Understanding the mechanism of adaptation is important for determining how the sensory [cells](#) of the inner ear work. While the research is not directly translational, it is an important first step in fixing and replacing cochlear function, potentially leading to technological improvements for better sound processing and treatment of hearing dysfunction down the line.

"The discovery that the original model of adaptation was incorrect is important in a couple of ways," says Peng. "In basic science, this has opened avenues for more research, including proposing a new model of how adaptation works. More importantly, hearing sensitivity and the range of hearing we are able to achieve relies on this process, so understanding this will help us better understand different types of hearing loss people experience."

More information: "Decades-old model of slow adaptation in sensory hair cells is not supported in mammals" *Science Advances* (2020).
[advances.sciencemag.org/lookup ...](https://advances.sciencemag.org/lookup...)
[.1126/sciadv.abb4922](https://doi.org/10.1126/sciadv.abb4922)

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