AUDITORY SYSTEM

Gerbils hear the light

Wrobel, C. et al. *Sci Transl Med* **10**, eaao540 (2018)

Cochlear implants have been an amazing success story, says Marcus Jeschke, an auditory neuroscientist who works with Tobias Moser at University Medical Center Göttingen in Germany. The devices, which consist of an external microphone and processor that transmits sound waves as electrical signals into neurons in the inner ear via implanted electrodes, have helped restore hearing to half a million people worldwide. But they could be better, he says.

The implants work well when it's quiet but less so when it's noisy, Jeschke explains. Neurons in different areas of the cochlea in the inner ear respond to different frequencies of sound, but the electric currents that the electrodes deliver tend to spread out too much. That can make close frequencies indistinguishable. Tonal languages like Chinese don't mesh well with the devices, nor does music.

To improve them, Moser's team is considering an alternative to electricity: light. In theory, Jeschke says, implanted light arrays could transfer different frequencies of sound to the cochlea more precisely than electrodes.

They've established the initial concept using optogenetic techniques in mice, but mice don't hear the same way people do. Most human speech patterns fall well below 1 kilohertz, says Jeschke, and lab mice can't resolve frequencies that low. Another rodent, the Mongolian gerbil, can.

Gerbils are the focus of their latest publication. They virally transduced a light-sensitive protein into adult animals and found even expression in neurons throughout the cochlea.

Sound energy changes quickly, so auditory nerves must be able to respond quickly. The protein they used, calcium translocating channelrhodopsin, has a lower light sensitivity than other options, which improved how quickly the neurons fired. Some would fire once despite repeated pulses—a problem for perceiving continuous sounds—but others continued to fire on repetitive stimulation.

That was enough to let the gerbils "hear" the light. Animals trained to move between compartments in a shuttlebox at the sound of a tone continued to do so after receiving a light pulse to their auditory nerves instead. Deafened animals learned to respond to the light accordingly too.

Jeschke says they'll continue on with gerbils, screening for even better channelrhodopsins and determining just how complex the sounds they deliver can be. And they want to show more than just auditory sensitivity to light. The gerbil ear may be tuned to the same range as a human, but gerbils don't rely on their hearing to communicate with one another, like people do. Jeschke says that the next animal to hear the light will be the marmoset, a vocal nonhuman primate that relies on chattering to socialize.

Ellen P. Neff

Published online: 24 August 2018
https://doi.org/10.1038/s41684-018-0147-z