Listening on a noisy planet: How neurons have 'meta-adapted' to cope with our rowdy world

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Credit: Macquarie University

A new study by researchers from Macquarie University has revealed the way that the brain handles the often noisy environments found on this

planet, with the results explaining why animals, including humans, can easily cope with both the still and quiet of early-morning parks to the bustle and hubbub of cafés and streets. The researchers discovered that as auditory neurons become more familiar with a sound environment, they speed up their adaption to the noisiness of that environment.

"We discovered that neurons quickly adapt to the current sound environment being experienced – quiet or loud – and adjust to maximise the transmission of information about the current environment," explained Professor David McAlpine, author on the study.

"However, what is really interesting is how these neurons adjust: their adaptation process itself adapts as sound environments become increasingly familiar. For example, after experiencing a sound environment five or six times, neurons are able to adapt twice as fast as when they first experienced it, in a process we've called 'meta-adaption'," he added.

The results suggest that an animal's ability to adapt to environments with different noise profiles is a more complex process than previously thought, and could also explain why some people find it difficult to follow a conversation in a noisy environment.

"Many otherwise normal-hearing listeners struggle to follow a conversation in background noise – a phenomenon known as 'hidden hearing loss' – hidden because it is not evident in gold-standard hearing tests. The discovery that the brain learns and adapts to different sound environments suggests one avenue we could explore to tackle this common communication problem," explained Professor McAlpine.

The study, which measured the neural response of guinea pigs – a species with a similar hearing range to our own – by exposing them to relatively quiet or loud unfolding soundscapes, also showed that parts of

the brain held onto these sound memories much longer than expected due to a feedback loop. Existing between the midbrain and the auditory cortex, the discovery of this loop by the researchers indicated a previously unknown connection between these two brain regions.

"One of the unusual things we found was that the midbrain – a part of the brain that is thought to retain information for only a few hundreds of milliseconds – was actually retaining the information it learned about how an environment sounded over many minutes, which was what allowed the auditory neurons to meta-adapt. When we blocked this loop the neurons could no longer adapt, indicating a relatively unexplored loop function between these brain regions," concluded Professor McAlpine.

More information: Benjamin L. Robinson et al. Meta-adaptation in the auditory midbrain under cortical influence, *Nature Communications* (2016). DOI: 10.1038/ncomms13442

Provided by Macquarie University