# Regularly stimulated axons do not pass on increases in performance to their neighbors, shows hearing study

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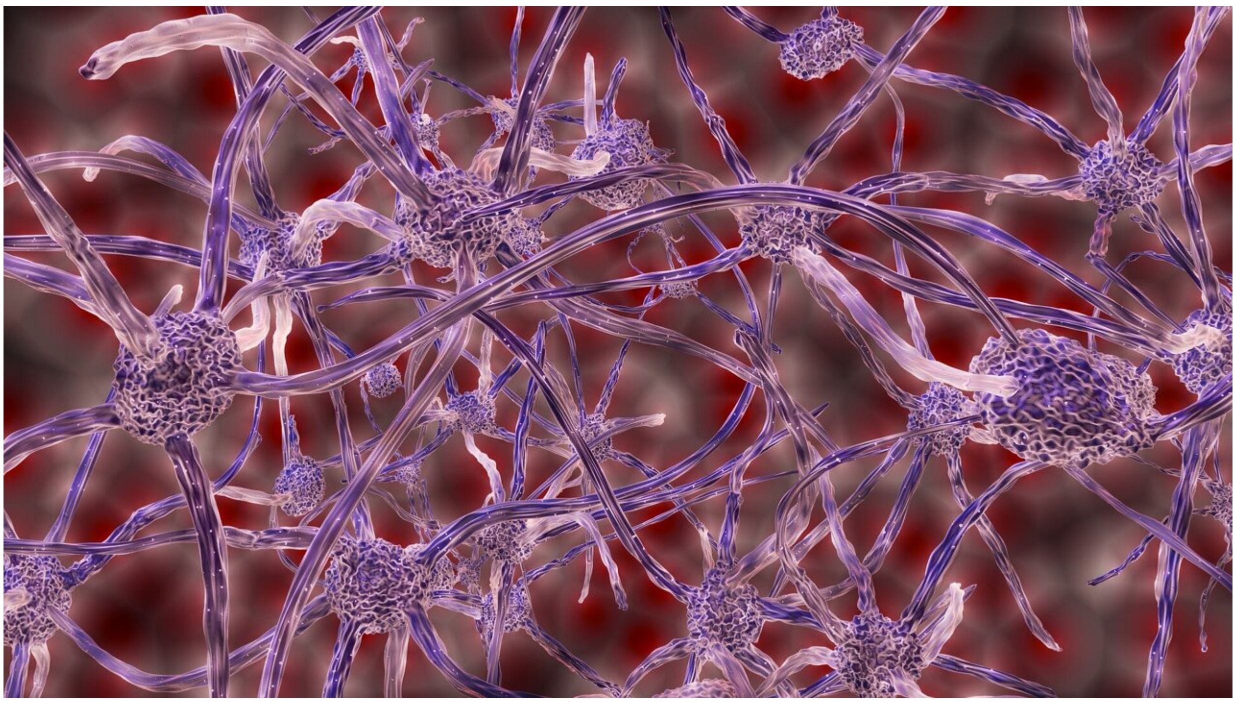

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A complex network of nerve fibers and synapses in the brain is responsible for transmission of information. When a nerve cell is stimulated, it generates signals in the form of electrochemical impulses, which propagate along the membrane of long nerve cell projections called axons. How quickly the information is transmitted depends on various factors such as the diameter of the axon.

In vertebrates, where the comparatively large brain is enclosed in a compact cranium, another space-saving mechanism plays a major role: myelination. This involves the formation of a biomembrane that wraps around the axon and significantly accelerates the speed of signal transmission. The thicker this myelin sheath, the faster the transmission.

"Even though myelination is an integral part of neural processing in vertebrate brains, its adaptive properties have not yet been comprehensively understood," says Dr. Conny Kopp-Scheinpflug, neurobiologist at the LMU Biocenter. She is the principal investigator of a study recently published in the *Proceedings of the National Academy of Sciences*, which reveals new insights into the principles of myelination.

The researchers investigated the question as to how sensory stimulation affects the formation of the myelin layers. "We know that axons which are regularly stimulated have enhanced myelin sheath thickness," explains Dr. Mihai Stancu, lead author of the paper.

Accordingly, regular training improves transmission capability. It was unknown, however, whether this change takes place at the level of individual nerve fibers or if adaptive myelination is also transferred to neighboring, passive axons in a fiber bundle.

To answer this question, the scientists investigated the neural activity of mice. "We focused on the auditory system, because it allows separate activation of the left and right neural circuits," explains Kopp-Scheinpflug. To this end, the team rendered the lab mice temporarily deaf in one ear by means of an earplug. This way, one side received stronger acoustic stimulation than the ear-plugged other side for the duration of the experiment.

"Surprisingly, all the nerve fiber bundles we investigated in the brain contained axons that carried information from the right ear as well as axons transmitting information from the left ear," says Stancu. The experimentally-induced one-sided deafness allowed the researchers to test their hypothesis.

Their results showed that in the mixed nerve fiber bundles, only the myelin sheaths of the axons that belonged to the non-plugged active ear were strengthened. Consequently, the active axons did not transfer adaptive changes in myelination to the other, passive fibers, even when they were located in close proximity.

"The principle seems to hold that each axon trains on its own," observes Kopp-Scheinpflug. "As such, the activity of one input channel cannot compensate for the deficits of another."

The authors conclude that varied sensory experience throughout the lifespan of a person is vitally important. "If you want to remain cognitively fit, you should give your brain comprehensive all-round training."

**More information:** Mihai Stancu et al, Ambient sound stimulation tunes axonal conduction velocity by regulating radial growth of myelin on an individual, axon-by-axon basis, *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2316439121

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