Neuron research could improve hearing loss restoration

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(PhysOrg.com) -- New research into the way our brain uses neurons to enable us to perceive sound and understand speech could fundamentally improve the design of current surgical implants and so help restore hearing in patients with profound hearing loss.

The findings, published on Tuesday, 4 May in IOP Publishing's Journal of Neural Engineering, demonstrate that frequency specific electrical stimulation can be used to activate the temporal firing of neurons in the human brain, which are thought essential for many speech features.

At the moment deaf patients are fitted with one of two types of implants, a cochlear implant (CI) or an auditory brainstem implant (ABI). The latter type is used for those who have a damaged cochlear nucleus (the first auditory processing site within the brain) or auditory nerve (the nerve that connects the cochlea in the ear to the brain) due to meningitis, a tumor or the trauma suffered in a car crash.

Patients fitted with ABIs only have limited sound perception despite the implant and can typically only increase their speech perception in conjunction with lip reading.

The researchers from La Trobe University, Victoria, Australia, and the Bionic Ear Institute, Victoria, Australia headed by Associate Professor Paolini have been conducting research into ABIs for the last six years with research results showing it is theoretically possible for an ABI to compensate for the difference between normal and ABI temporal neural firing - the firing rate of a neuron and the precise temporal position of when it fires.

It is thought that the brain uses both firing rate and firing timing to pass on messages, meaning that implants which can activate both through electrical stimulation could vastly increase a patient's ability to hear and understand speech.

The researchers write, "Understanding the auditory system's temporal response to electrical stimulation will aid in future ABI design and stimulation strategies."

The next step is to build and test a new stimulation strategy for ABIs and for cochlear implants, which restores the brain's temporal natural firing pattern.

With an increasing number of up to 1000 implantations of ABIs per year in patients with genetically conditioned tumor growth, and a growing number of other pathologies such as those born without an auditory nerve for example, better implant design will make a significant difference for patients otherwise facing substantial hearing loss.

More information: Journal paper: iopscience.iop.org/1741-2552/7/3/036004 provided for information purposes only.