MedicalXpress

How does the human brain memorize a sound?

June 3 2010

Sound repetition allows us to memorize complex sounds in a very quick, effective and durable way. This form of auditory learning, which was evidenced for the first time by French researchers from CNRS, ENS Paris, and Paris Descartes and Toulouse universities, is believed to occur in daily life to help us identify and memorize sound patterns; it allows, for example, immediate recognition of sounds which become familiar through experience, such as the voice of relatives.

The same mechanism is involved in the relearning of certain sounds, in particular when using hearing aids. This study, which has just been published in the journal *Neuron*, opens new perspectives for understanding the process of auditory memory.

“Until now, the only available data on acoustic memorization concerned simple sounds or language”, points out Daniel Pressnitzer. Three French researchers set themselves the challenge of addressing complex sounds and studying our ability to memorize them, as little was known on the subject.

In order to investigate how auditory memory is formed, the researchers subjected volunteers to various noise samples: these noises were generated in a totally random and unpredictable way to ensure that the volunteers would never have heard them before. Furthermore, these original complex sound waves had no meaning, and were perceived at first as an indistinct hiss. Listeners were not told that an identical complex noise pattern could be played several times during the

experiment.

Using this fairly simple protocol, the scientists discovered that our ear is remarkably effective in detecting noise repetitions. Listeners nearly always recognized the noise pattern that had been played several times; two listenings were enough for those with a trained ear, and only about ten for less experienced ears. Sound repetition therefore induces both extremely rapid and effective learning, which occurs implicitly (it is not supervised). In addition, this memory for noise can last several weeks. A fortnight after the first experiment, volunteers identified the noise pattern again, at first attempt.

The scientists have demonstrated the existence of a form of fast, solid and long-lasting auditory learning. Their experimental protocol has proven to be a relevant and simple method that could make it possible to study auditory memory in both humans and animals. These results imply that a mechanism for rapid auditory plasticity - that is, a mechanism involved in an auditory neuron's ability to adapt its response to a given sound stimulant - plays a very effective role in the learning of sounds. This process is likely to be essential to identify and memorize recurrent sound patterns in our acoustic environment, such as the voice of relatives. It has all the characteristics considered necessary for human beings to learn to associate a sound with what produces it.

The same mechanism may also be involved in relearning, which is often inevitable when hearing suddenly changes. This is true of hearing-impaired people who start using hearing aids. A period of adaptation to their prosthesis is necessary so they can get used to hearing sounds they no longer heard or perceived differently. The researchers hope that one day they will be able to study the effect of the modifications introduced by hearing aids on re-learning more in depth.

More information: Sound illustrations: audition.ens.fr/memonoise/

Rapid formation of robust auditory memories: Insights from noise. Trevor R. Agus, Simon J. Thorpe, Daniel Pressnitzer. Neuron. May 27, 2010.

Provided by CNRS