Brain Imaging in People with Tinnitus

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What an exciting year 2006 was. Not only did we begin our ATA-funded brain imaging study of tinnitus, we received separate donations that have allowed us to expand the study in important ways.

The ATA-funded part of our research uses a particular imaging method called *functional magnetic resonance imaging* (fMRI). This technology is very similar to the clinical MRI scanning that many people undergo for various medical reasons. However, unlike most clinical scans, it shows the activity (function) of the brain rather than its structure. For instance, when sounds are played for a study participant in the lab, the hearing centers of their brain become active. We can measure this activity with fMRI.

We currently use fMRI to determine if sound causes abnormally high levels of brain activity in people with tinnitus. Our results should indicate if people who have tinnitus experience abnormal "amplification" in the hearing centers of the brain, which may raise brain activity levels and increase the loudness of the sound they hear. A similar amplification may also account for the tinnitus itself. Even in the absence of sound, there is activity in the hearing centers of the brain. We hypothesize that this normally unheard activity may be amplified in people with tinnitus to the point that they can hear it.

Patient diversity, approach diversity

But what if tinnitus arises in different ways in different people – sometimes from amplified brain activity and sometimes in completely different ways? Given how often tinnitus differs from person to person, this possibility seems likely. No single brain scan shows everything there is to know about the brain. So if the diversity of brain abnormalities that lead to tinnitus matches the diversity of tinnitus itself, detecting the abnormalities behind each and every person's tinnitus will almost certainly require imaging the brain in more than one way.

Our hope is that by studying each research subject with several brain imaging approaches instead of just one, we will increase the chances of identifying abnormalities in each person with tinnitus.

Therefore, we have begun examining additional aspects of the brain with fMRI during our sound-stimulation studies. The additional experiments, "piggybacked" onto those funded by ATA, are possible thanks to funding from several generous donors. And the expertise of colleagues at the University of Regensburg in Germany and the Martinos Imaging Center in Boston greatly enhanced our experiment design.

The additional experiments include using fMRI to examine how the brain responds to emotional stimuli. This may reveal the relationship between emotional brain centers and tinnitus. We are also examining the function of the brain using a technique very different from fMRI, called *magnetoencephalography* (MEG). This particular technology measures very small magnetic fields in the brain, yielding promising preliminary results in several research studies. Our hope is that by studying each research subject with several brain imaging approaches instead of just one, we will increase the chances of identifying abnormalities in each person with tinnitus.

Thanks to ATA and generous donations we are off and running, imaging people on a weekly or twice-weekly basis. While cautious in our optimism, we are excited by the possibilities for the future, particularly the prospect that brain imaging might eventually help match patients to treatments. The literature on tinnitus contains many anecdotes about medications or other therapies that alleviated one person's tinnitus, but not another's. Perhaps, one day, we will be able to use an individual's brain scans to predict their particular, optimal treatment. ((

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