Medical Xpress

Are expectations more important than sound for auditory processing?

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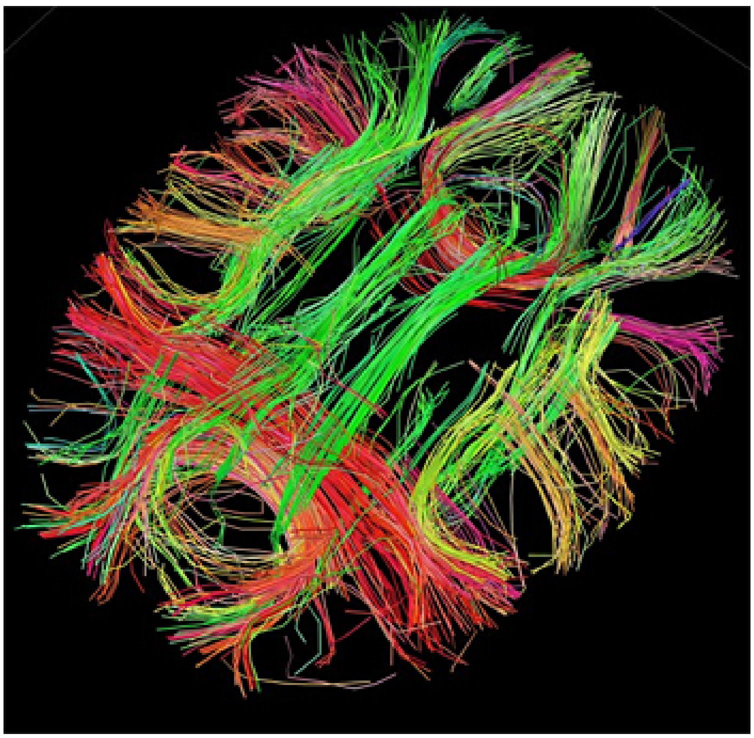

White matter fiber architecture of the brain. Credit: Human Connectome Project.

What affects how we hear? Do we hear sounds as they are, or do our expectations about what we are going to hear instantaneously shape the way sound is processed? These are questions that Bournemouth University's (BU) Dr Emili Balaguer-Ballester and colleague Andre Rupp of Heidelberg University have been considering in their research into auditory central processing.

Through the use of computational neuroscience models, Dr Balaguer-Ballester and his team intend to map the way that the brain processes sound. "Almost 80% of connections between central and pre-cortical areas during sound processing seem to be top-down i.e. from the brain to the auditory peripheral system and not bottom-up, which is perhaps unexpected," he explains. "As sound comes from an external stimulus, it would be fair to assume that most of our processing occurs from what we hear, but that is apparently not the case. What your brain expects to hear can be as important as the sound itself."

This is backed up by the fact that it takes hundreds of milliseconds for sound to be processed along the neurons from the ear to the brain, which does not explain how we can immediately recognize the sex of a speaker or identifying a melody after just a few milliseconds.

Until recently, monitoring neural activity at different levels of the auditory system in such detail simply was not possible. However, thanks to technological advances, Andre Rupp and his team are able to combine magneto and electroencephalography to map brain activity through recording electromagnetic currents which occur naturally in the brain and brainstem simultaneously. This allows for very detailed temporal information about how the brain processes sound to be recorded. Dr Balaguer-Ballester, a physicist by background, is then able to use the data from Heidelberg to develop models to show in detail how the brain processes sound.

The potential impact of their work is significant. For instance, by understanding how sound is processed, new treatments for auditory processing disorders can potentially be found in the future. As Dr Balaguer-Ballester says: "This could be the first step towards a better understanding of auditory central processing disorders in children. If their learning difficulties stem from the way their brain processes sound and not in their peripheral auditory system, this requires very different treatment to a child who develops serious hearing loss after an illness. Central processing disorders can lead to problems such as the delay of language development in children, so it is important to be able to pinpoint the neural parameter which is altered, in order to appropriately treat the cause of such an alteration."

For Dr Balaguer-Ballester, publishing this research open access was important as it meant that it was accessible much quicker than through more traditional journals. "For postgraduate students and PhD students, this is really important," he explains, "as they are able to see their articles published without delay which helps their careers. It also meant that research is freely available to use by a much wider audience."

More information: "Understanding Pitch Perception as a Hierarchical Process with Top-Down Modulation." *PLoS Comput Biol* 5(3): e1000301 DOI: 10.1371/journal.pcbi.1000301

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