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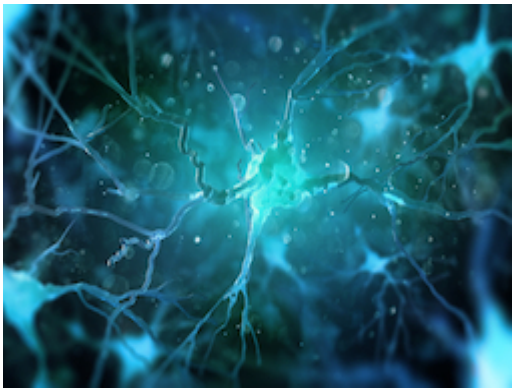
Using musical cues to learn physical tasks can change brain structure

A new study shows that using musical cues to learn physical tasks significantly develops an important part of the brain.



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Sound is frequently used to support movement learning and rehabilitation, and moving around to music is something enjoyed by many. But the neural basis for this relationship remains unclear. A recently published paper outlines research done by a EU-supported project to analyse possible connections. Their work shows that practicing a basic movement task increases structural connectivity on white matter pathways, between the regions of the brain that control movement and process sound.

Current evidence shows corticospinal tracts, pyramidal tracts, corpus callosum and internal capsule are all impacted by high levels of musical training. Other evidence suggests that musical training can specifically affect auditory-motor circuitry. The aim of the study was to use diffusion tensor MRI (DT-MRI) and probabilistic neighbourhood tractography to investigate whether a short period of left-handed, music-cued motor training would cause higher fractional anisotropy (FA) values in the are of the brain under study.

FA is frequently used to infer information about white matter structure and connectivity while DT-MRI and tractography use measurements of the direction and magnitude of water molecule diffusion in segmented tracts. Mean (MD), axial (AD) and radial (RD) diffusivity measure the total magnitude of water diffusion, providing an insight into underlying biological structures.

Having established their method of analysis, the team designed a novel training

paradigm in which participants learned four sequences of eight finger-to-thumb opposition movements with their left, non-dominant hand, using a visual display either with (Music group) or without (Control group) musical cues. The subjects then spent 20 minutes of training three times a week over four weeks. Diffusion tensor MRI and probabilistic neighbourhood tractography identified FA, axial (AD) and radial (RD) diffusivity before and after training.

Thirty healthy volunteers aged 18–30 years were recruited using an online student recruitment website at the University of Edinburgh, UK. They were all right-handed and had no history of neurological or psychiatric disorders. The average amount of musical training any of the participants had experienced was 1.4 years with a maximum of six and none were currently involved in musical activity. All underwent initial MRI scanning and behavioural assessment before the experiment was launched.

Once the experiment had run, the participants were scanned again. The result showed that the music group displayed a significant increase in structural connectivity in the white matter tract that links auditory and motor regions on the right side of the brain. The non-music group showed no change.

While we have long known people respond to music, the study suggests that music makes a key difference to brain structure. Their research provides evidence that even a short, relatively low-intensity period of auditory-motor training can induce rapid, structural changes in the arcuate fasciculus. Researchers hope that future study with larger numbers of participants will examine whether music can help with special kinds of motor rehabilitation programmes which can, for example, be use to help stroke patients.

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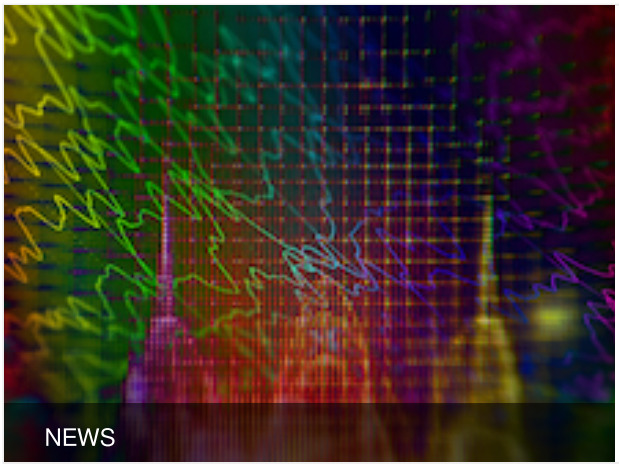

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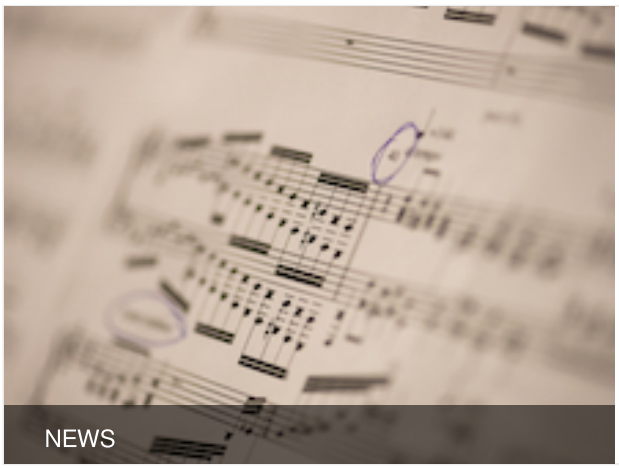

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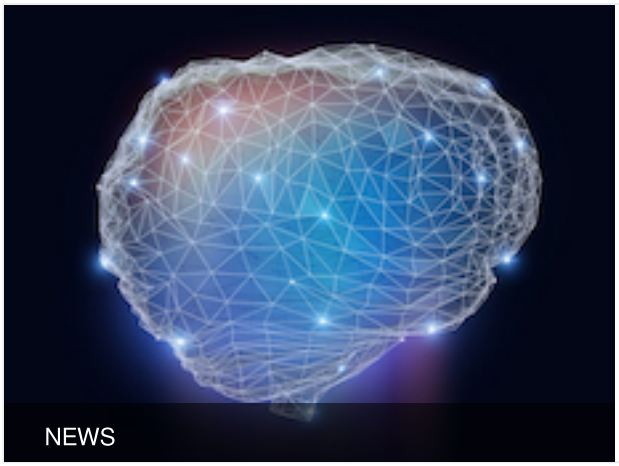

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