**Dance and music alter the brain in opposite ways**

Written by Tim Newman

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**Fascinating research, published in the journal *NeuroImage,* finds distinct changes in sensory and motor pathways in the brains of dancers and musicians. However, the changes in white matter are at opposite ends of the spectrum.**

In the majority of earth's most ancient cultures, dancing and music is wonderfully prevalent. This ubiquitous desire to make music and move along to it has been carried through into modern culture. Although some children may dread their trumpet tutorial and others would rather play their Xbox than attend ballet lessons, a new study shows that our parents were right all along. The recent findings demonstrate that music and dance can make significant neurological changes.

Researchers from the **International Laboratory for Brain, Music, and Sound Research in Montreal, Canada,** recently set out to understand what changes within the brain music and dance might produce, and how they compare with each other.

Earlier studies have shown that music training from a young age can make changes to pathways within the brain. A review published in 2014 concluded that the clearest changes that musical training makes in the brain are to the connections that run between the two hemispheres (the corpus callosum). However, to date, the brains of dancers have received much less scientific attention.

Although both skills involve intense training, dance focuses on integrating visual, auditory, and motor coordination, whereas musicianship primarily concentrates on auditory and motor information.

**Imaging artist's brains**

Using an advanced imaging technique called *diffusion tensor imaging,* the team of investigators looked in detail at the white matter structure of dancers, musicians, and individuals with training in neither. The differences between dancers and musicians were more marked than perhaps might be expected.

*"We found that dancers and musicians differed in many* ***white matter regions,*** *including sensory and motor pathways, both at the primary and higher cognitive levels of processing."* Lead author Chiara Giacosa

The pathways that were **most affected were bundles of fibers that link the sensory and motor regions of the brain and the fibers of the corpus callosum that run between the hemispheres. In the dancers, these sets of connections were broader (more diffuse); in musicians, these same connections were stronger, but less diffuse, and showed more coherent fiber bundles.**

According to Giacosa: *"This suggests that dance and music training affect the brain in opposite directions, increasing global connectivity and crossing of fibers in dance training, and strengthening specific pathways in music training."*

**Why the white matter differences?**

The differences observed may be because dancers train their whole body, which has a "broader representation in the neural cortex," encouraging fibers to cross over and increase in size; whereas musicians tend to focus their training on specific body parts such as the fingers or mouth, which will have smaller cortical representations in the brain.

Another interesting result was that dancers and musicians differed more from each other than when compared with the group of untrained control subjects. This could be for a number of reasons, as Giacosa explains: "[...] our samples of dancers and musicians were specifically selected to be pure groups of experts, which makes it easier to differentiate between them." On the other hand, the control group was a more diverse group with a range of interests and life experiences.

These results are not just interesting, they could have ramifications for education and rehabilitation. According to senior author Prof. Virginia Penhune: *"Understanding how dance and music training differently affect brain networks will allow us to selectively use them to enhance their functioning or compensate for difficulties and diseases that involve those specific brain networks."*

Dance and music therapy is being investigated for its potential use in the treatment of diseases such as Parkinson's and autism. Prof. Penhune hopes that these findings will spur further research into the use of the arts in the treatment of disease.

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 ***References***

 Dance and music training have different effects on white matter diffusivity in sensorimotor pathways, Chiara Giacosa et al., NeuroImage, doi: http://dx.doi.org/10.1016/j.neuroimage.2016.04.048, published online 15 July 2016, abstract.

**Abstract**

*Dance and music training have shared and distinct features. Both demand long and intense physical training to master. Dance engages the whole body, and requires the integration of visual, auditory and motor information. In comparison, music engages specific parts of the body and primarily requires the integration of auditory and motor information. Comparing these two forms of long-term training offers a unique way to investigate brain plasticity. Therefore, in the present study we compared the effects of dance and music training on white matter (WM) structure using diffusion tensor imaging (DTI), and examined the relationship between training-induced brain changes and specific measures of dance and music abilities. To this aim, groups of dancers and musicians matched for years of experience were tested on a battery of behavioural tasks and a range of DTI measures.*

*Our findings show that dancers have increased diffusivity and reduced fibre coherence in WM regions, including the corticospinal tract, superior longitudinal fasciculus and the corpus callosum. In contrast, musicians showed reduced diffusivity and greater coherence of fibres in similar regions. Crucially, diffusivity measures were related to* ***performance*** *on dance and music tasks that differentiated the groups.* ***This suggests that dance and music training produce opposite effects on WM structure.*** *We hypothesize that intensive whole-body dance training may result in greater fanning of fibres connecting different brain regions, an increase in crossing fibres, or larger axon diameter. In contrast, musical training may result in more focused enhancements of effector-specific pathways. These findings expand our understanding of brain plasticity by emphasizing that different types of training can have different long-term effects on brain structure (Takeuchi et al., 2011; Baer et al., 2015).*

 Concordia Montreal news release, accessed 7 October 2016.

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