Laterisation Differences in Grey Matter Volume in Musicians: A Voxel-Based Morphometry Study

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Introduction

The study of the brain in people who perform a repetitive motor function for long periods of time, such as professional musicians, is an ideal model for brain plasticity and allows researchers to investigate whether previously shown functional cerebral adaptations in response to skill learning or sensory stimulation are correlated with long-term global anatomical changes. Several studies have investigated the specialised skills of musicians, however the neural correlates of musical skills are not fully understood and also the association of these skills with particular characteristics of brain anatomy are not yet fully established. Previously, two studies have looked across the whole brain space for macro-structural differences between musicians and non-musicians; one studied keyboard players (1) and the other included a wide range of musical instrument players (including strings, woodwind, brass and percussion) (2). Our study extended this by looking at the differences associated with bilateral and predominantly unilateral practice by comparing a group of professional pianists and a group of professional violinists to a non-musician group.

Methods

This study used structural MRI to determine whether functional cerebral adaptations could lead to volumetric changes detectable on an anatomical level. Voxel-based morphometry (VBM) methodology was used to detect grey matter (GM) volume differences between professional musicians (combined musicians, n=29; pianists, n=15; violinists, n=14) and non-musician control subjects (n=15). High-resolution anatomical images were acquired using a T1 weighted MP-RAGE sequence with a TE of 4 ms, TR of 9.7 ms, , TI/TD=300ms, Flip Angle of 8^{o}, matrix 256 x 256 and FOV of 250 mm on a 1.5 T Siemens Vision MR system. 128 transverse slices (2 mm thickness) were obtained parallel to AC-PC line. Volumes were analysed using SPM2 (Wellcome Department of Cognitive Neurology, London).

Results

Figure 1 shows the results of the VBM analysis. Significant differences in GM volume in the sensory-motor, and auditory brain regions were found between professional musicians (combined musicians, pianists, and violinists) and non-musician controls. Areas of significant regional increase in GM volume were found bilaterally in the combined musician group (p<0.0001 uncorrected) and the pianist group (p<0.0001 uncorrected), and unilaterally (right cerebral cortex) in the violinist group (p<0.001 uncorrected).

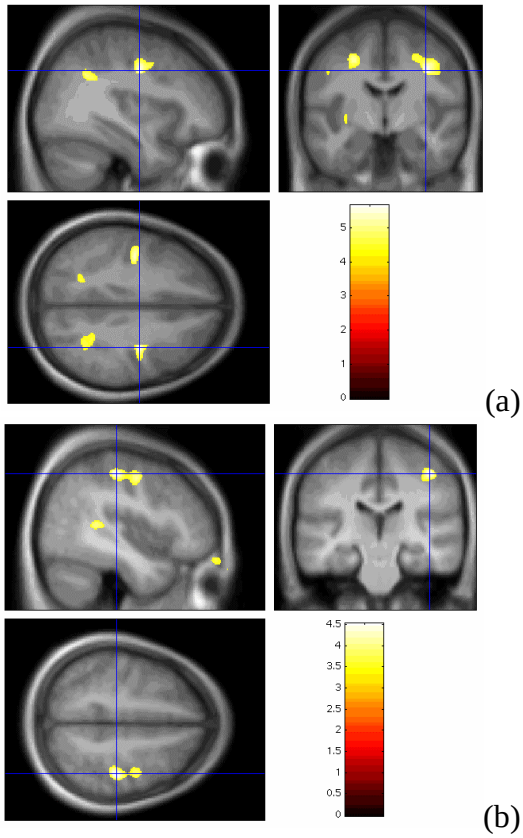

Figure 1. Regions of significant GM increase in a) pianists and b) violinists compared to controls

Conclusions

It has been suggested that these regional GM volume differences may represent structural adaptation in response to long-term musical training and the repetitive practice of those musical skills. Results from this study have supported the notion that the VBM methodology is a sensitive technique for detecting regional brain changes.

References

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