Multimodal approach: Grey matter differences in Early and Late-trained musicians

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- INTRODUCTION -

✧ Does early musical training have long-lasting effects on brain structure?

✧ Previous neuroimaging studies have shown structural/functional changes in the brain that are greater for musicians who began training before age 7 [1, 2].

✧ However, these studies did not control for inherent differences between the groups in the duration of musical training, and did not measure performance.

✧ Behavioral studies show that when groups are matched for training, early-trained musicians show enhanced performance on rhythm synchronization tasks [3, 4].

✧ The current study used voxel-based morphometry (VBM) and cortical thickness (CT) analyses to investigate possible grey matter differences between early and late-trained musicians.
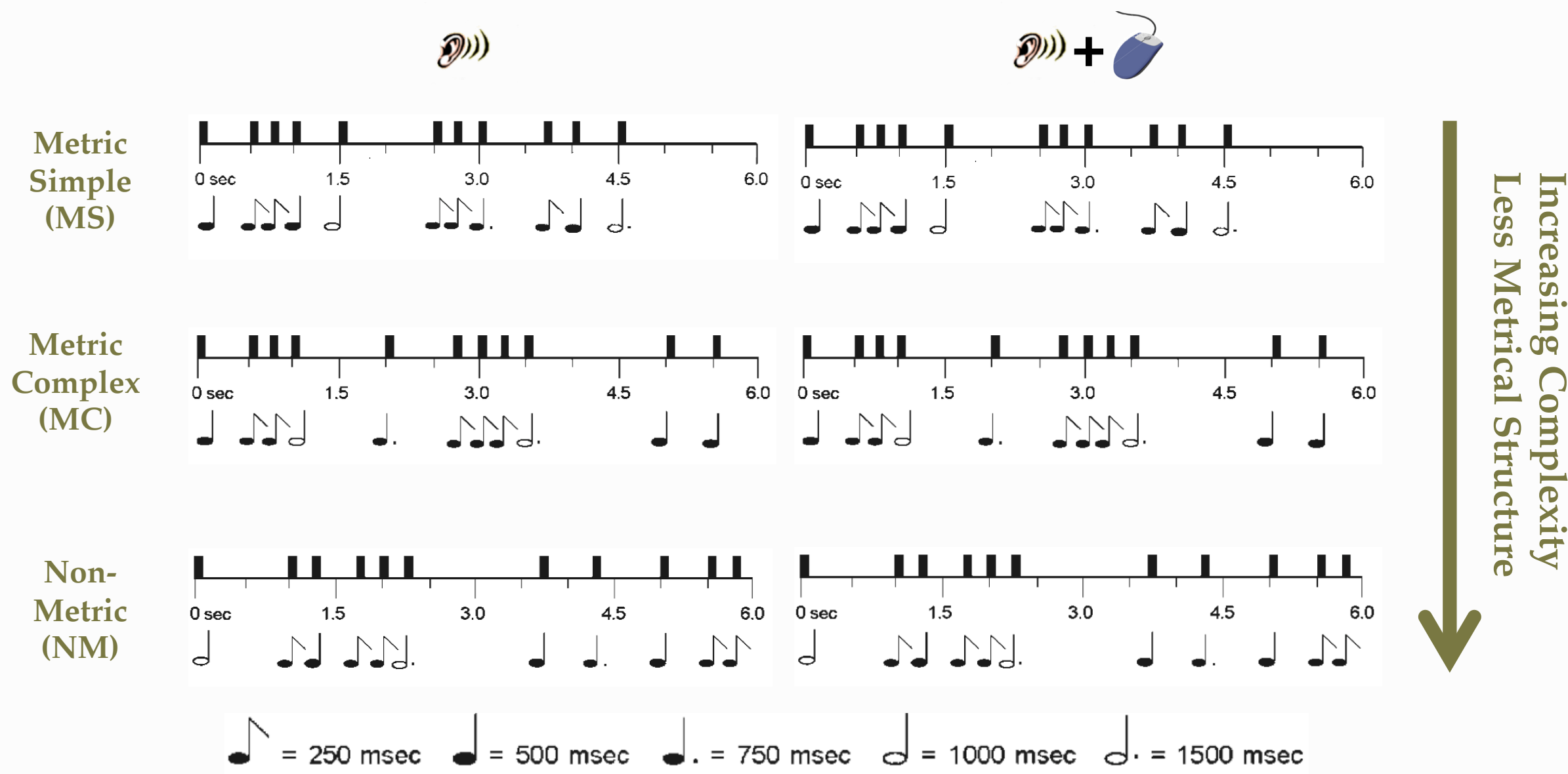
-MATERIALS & METHOD -

Participants:

✧**Early-Trained (ET; N=15)** musicians - began training before age 7
✧**Late-Trained (LT; N=15)** musicians - began training after age 7

Group	Onset Age (yrs)	Formal Training (yrs)	Playing Experience (yrs)	Current Practice (hrs)
ET	5.9 (1.2)	11.7 (4.0)	16.9 (4.1)	15.2 (10.0)
LT	10.5 (2.0)	10.0 (4.4)	15.9 (4.7)	14.4 (7.8)
	$p < 0.01$	n.s.	n.s.	n.s.

Auditory Rhythm Synchronization Task[5]:

Metric Simple (MS)
Metric Complex (MC)
Non-Metric (NM)

Increasing Complexity
Less Metrical Structure

♪ = 250 msec ♩ = 500 msec ♩. = 750 msec ♩ = 1000 msec ♩. = 1500 msec

Melody/Phoneme Discrimination Task[6]:

Simple
 → *Same or different?*

Transposed
 → *Same or different?*

Phoneme
KOH… ROO… RAH… NAH… FOO
KOH… ROO… RAH… YAH… FOO → *Same or different?*

Scanning Protocol and Analyses:

-T1-weighted images of 1mm^3 (MPRAGE+, TR 2300 ms, TE 2.94 ms, TI 900 ms, 176 slices, flip angle 9°)

-All analyses controlled for Age & Sex
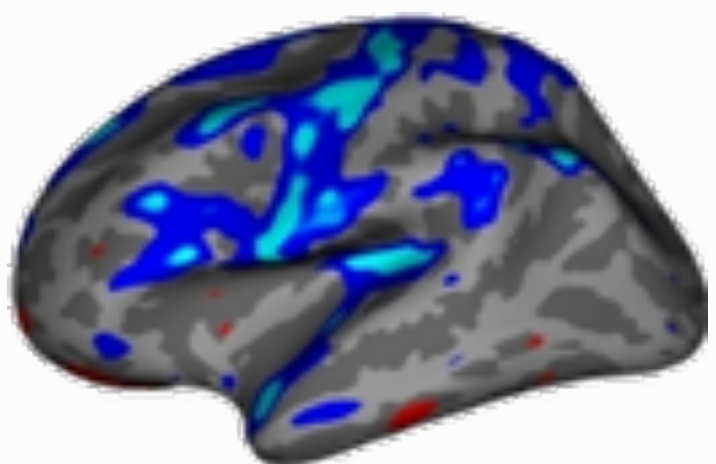
-Siemens 3T Scanner - 32 channel head coil

-Analysis conducted using FSL-VBM pipeline[7,8], carried out using FSL tools[9]

-Gaussian smoothing kernel with a sigma of 2mm

-Statistical comparisons conducted with FSL's randomise using Threshold-Free-Cluster-Enhancement (5000 permutations)
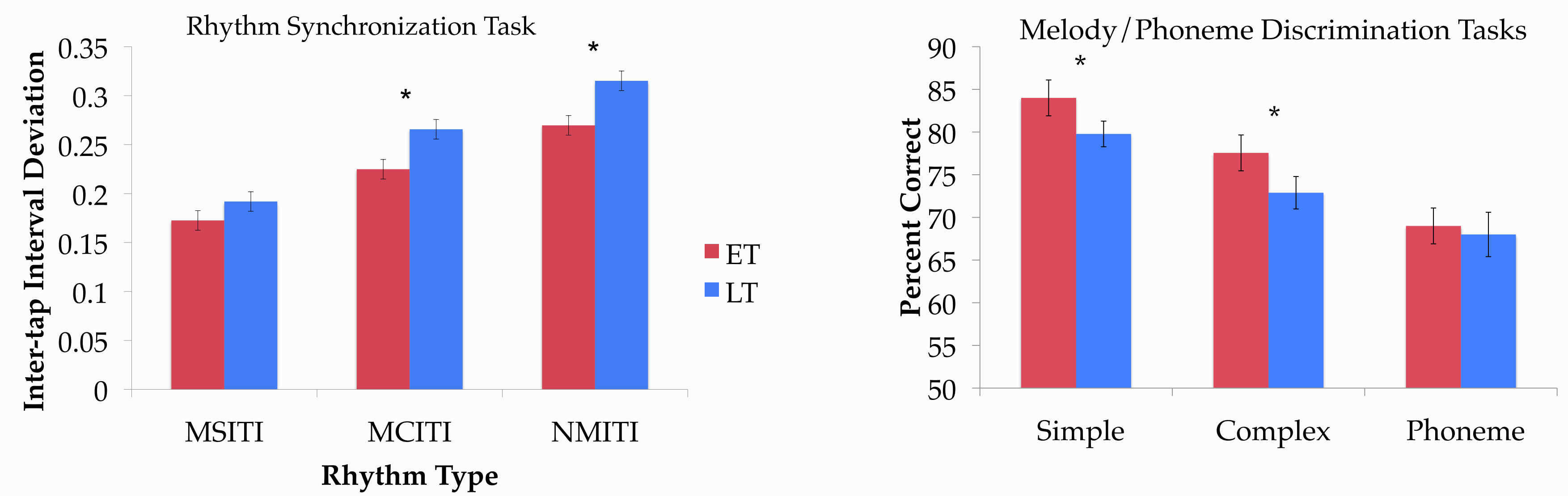
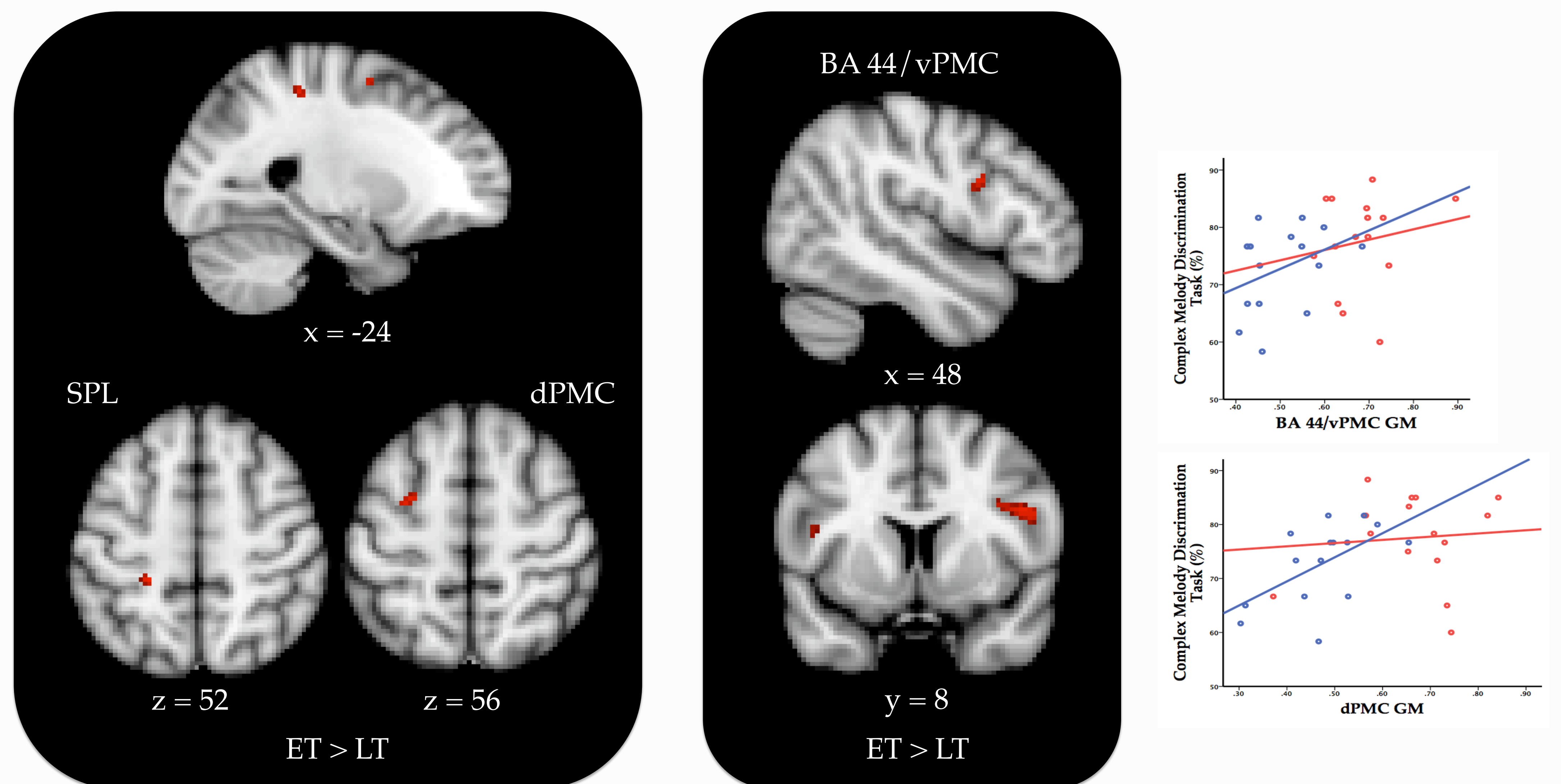-Result thresholds ranged from p < 0.001 to p < 0.0025 (uncorrected)

-Cortical reconstruction and volumetric segmentation was performed with the Freesurfer image analysis suite[10,11]

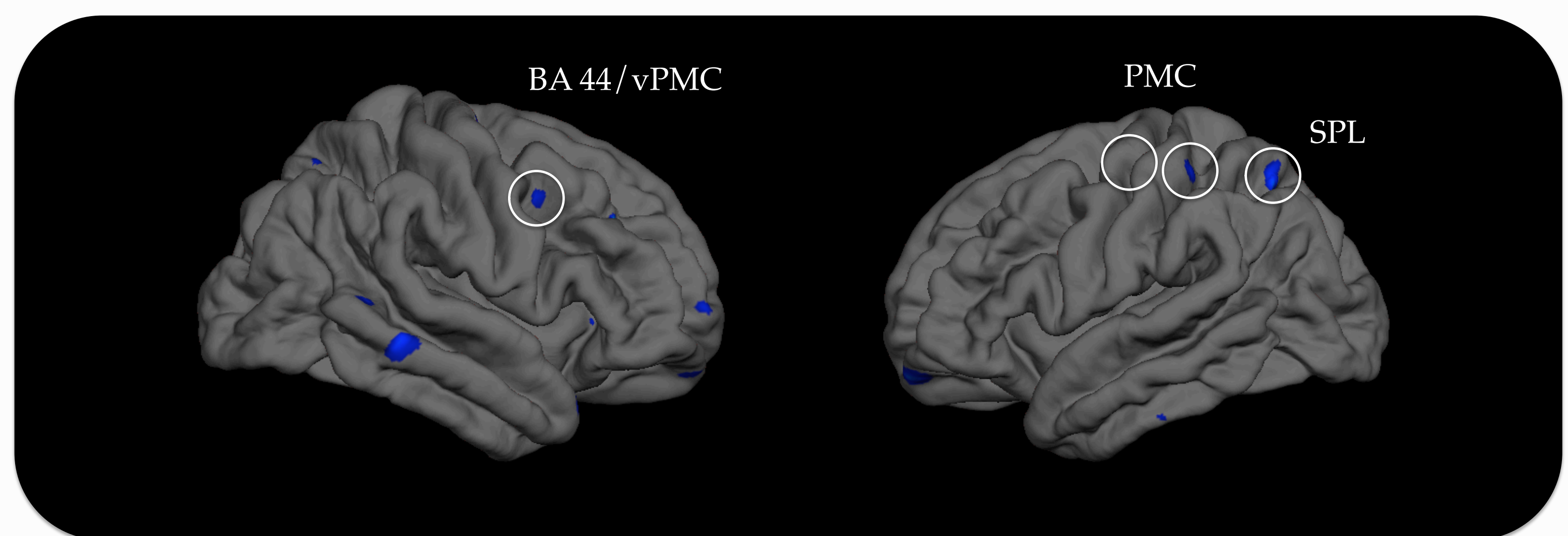-Result thresholds associated with p < 0.001 to p < 0.005 (uncorrected)

- BEHAVIOURAL RESULTS –

- VBM RESULTS -

- CT RESULTS -

-DISCUSSION –

✧These results show that early musical training produces long-term effects on behavior and brain structure, consistent with a possible sensitive period.

✧ET musicians showed greater GM volume in the dPMC and BA 44/vPMC that had previously been shown to be engaged in functional studies using behavioral tasks shown to differentiate the groups.

✧The results of the GM VBM were complimented by the results of cortical thickness analyses, which showed group differences in similar areas (PMC, SPL,BA 44/vPMC).

✧Multimodal structural imaging can provide complimentary information in examining brain structure. The precise relationship between the measures will continue to be explored.

- REFERENCES -

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