Differences in Cortical Structure between Aging Choral Singers and Non-singers

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Introduction

- Normal aging is associated with widespread structural brain decline [1,2], which can lead to decline in cognitive and language abilities [3,4].

- However, the brain remains plastic throughout the entire life. Professional musical activities, such as playing a musical instrument and singing, are powerful promoters of structural brain plasticity in aging [5,6].

- **Choral singing** is a more accessible musical activity than professional musical activities that could also induce structural plasticity and slow down cognitive decline, but the effects of choral singing are still largely unknown.

Objective: investigate, using surface-based morphometry, the moderating effect of choral singing on structural brain aging.

Method

Participants

- 82 healthy right-handed participants were recruited and divided into two groups: 41 non-singers (54±19 years [20-86 years], 21 F) and 41 choral singers (55±19 years [22-87 years], 27 F).

Non-singers were defined as individuals not involved in regular group singing.

Choral singers were defined as individuals involved in group singing activities for 2 years or more and practising for a minimum of 60 consecutive minutes per week.

- **Cognitive testing** included the Montreal Cognitive Assesment (MoCA) [7], Running Span and n-Back tasks (auditory verbal working memory tasks), the Test of Attention in Listening (auditory attention task) [8] and a speech perception in noise task.

- Preliminary analyses were conducted on a subset of 30 non-singers (50±20 years [20-86 years], 17 F) and 31 singers (52±18 years [22-87 years], 21 F) matched for sex ($\chi2 = .796$, $p = .372$), age ($t = -.179$, $p = .858$), years of education ($t = .569$, $p = .571$) and scores at the MoCA ($t = -.697$, $p = .489$).

MRI

- T1-weighted 3D-MPRAGE sequence (TR = 8.2 ms, TE = 3.7 ms, FoV = 240 mm2, matrix 240 × 240, 180 slices/volume, no gap, 1mm3) with a Philips Achieva 3T.

- Processing with Freesurfer 6 (Figure 1) [9,10] with the Destrieux 2009 atlas [11].

- Surface (S), Volume (V) and Thickness (T) were extracted for each ROI and adjusted for head size differences: value = (region value/total hemisphere value) [12].

- **Moderation analysis** (Figure 2) were conducted to investigate the moderating effect of choral singing on the relation between aging and brain structure.

Figure 1. MRI Preprocessing

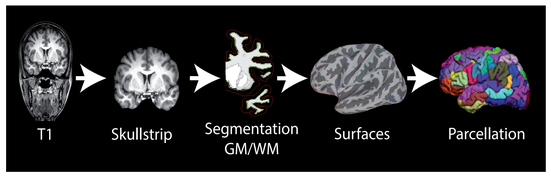
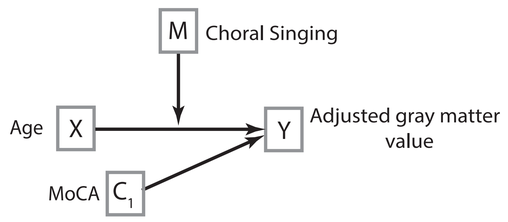


Figure 2. Moderation Model



Preliminary MRI Results

An effect of Singing was found on the left angular gyrus (T: β = -.0252, p = .0257), left planum polare (S: β = -.0005, p = .0135), right supramarginal gyrus (S: β = .0016, p=.0145), right postcentral gyrus (V: β= .0013 , p=.0081) and right planum temporale (S: β = .0005, p = .0333, V: β = .0005, p = .0375) (Figure 3).

Interactions between Age and Singing were found on the left opercular part of the inferior frontal gyrus (T: β = .0022, p = .0004), left superior parietal lobule (V: β = -.0001, p =.0235), right middle frontal gyrus (S: β = -.0001, p = .0325), right orbitofrontal cortex (T: β = -.0019, p = .0429), bilateral angular gyrus (Left: S: β = .0001, p = .0398; Right: V: β = .0001, p = .0432) and bilateral precuneus (Left: V: β = -.0001, p = .0201; Right: V: β = -.0001, p = .0095) (Figure 4).

Figure 3. Effect of Choral Singing

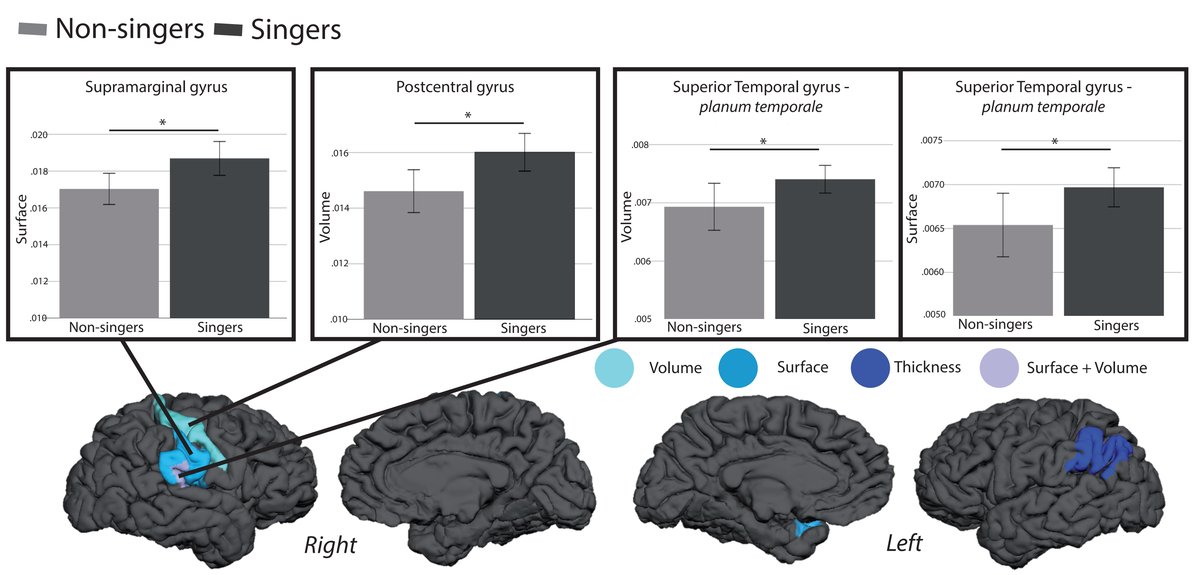
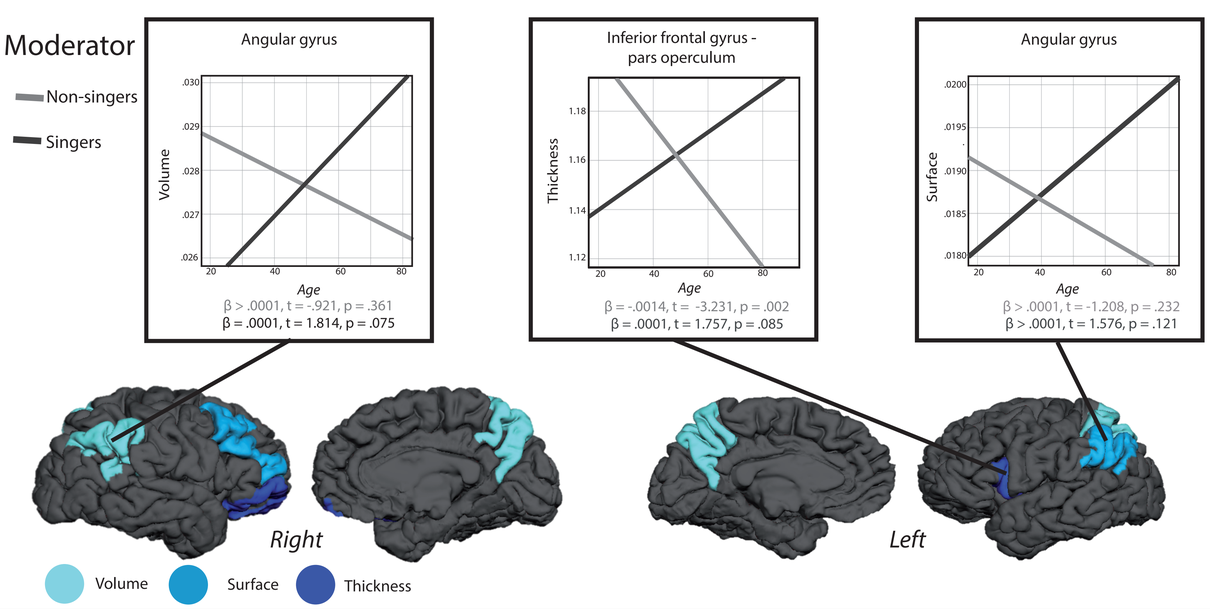


Figure 4. Interaction Age x Choral Singing



Discussion

- These preliminary results show that the impact of singing on brain aging is complex and spatially heterogeneous, and suggest that choral singing might be a driver of experience-dependent structural brain plasticity in aging.

- These structural differences may lead to differences in cognition and language abilities. These relations are under investigation.

References

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