Does the absence of auditory input to the cerebral nervous system during development lead to changes in the structure of the brain?

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Methods (cont.)

Participants
25 deaf native ASL signers. (14 women, 11 men; Mean age 23.8 years. SD 4.1, range 19-38).
25 hearing non-signers (14 females, 11 males) Mean age 28.5 years, SD 4.5, range 22-39).
All right-handed participants were matched for gender and age.

Surface reconstructions and cortical thickness analysis
Three 1.5 x 1.5 x 94 structural MRIs were obtained from each individual using a 1.5 T GE Signa scanner. MRI data were averaged and reconstructed using FreeSurfer (Dale et al. 1999).
Distances between vertices of white matter and pial surfaces (Fig.1 and Fig 2) were calculated to create cortical thickness map for each individual (Fig 3.)
Cortical thickness maps from deaf and hearing groups were analyzed with ROIs previously traced by Allen & Emmorey, 2008 for Heschl's gyrus (HG), planum temporale (PT), and superior temporal gyrus (STG). Whole brain analysis was also performed using general linear model analysis.

Results

Does the average thickness, accounting for age and gender, differ between deaf and hearing?

Group statistics:

- Right Lobe
- Left Lobe

- Whole brain analysis found significant increase in cortical thickness for deaf group in the left posterior middle temporal gyrus and lateral occipital gyrus in both right and left hemispheres.
- The ROIs results show no significant differences between deaf and hearing groups in the cortical thickness for HG: F (1,43) = 1.38, ns; PT F (1,43) = 1.03, ns, and STG F < 1, ns.

Conclusion

No significant difference in the ROIs for cortical thickness suggests that absence of auditory sensory inputs does not lead to thinner neuronal density within primary auditory cortex and its adjacent region (PT) in humans. The neuronal density in those areas is possibly maintained through cross-modality plasticity and function compensation from other brain regions as suggested in Rauschecker et al., 1995; Bavelier & Neville 2002, and Marabeta et al., 2009.

The increased thickness in the left posterior middle temporal gyrus and lateral occipital gyrus in both right and left hemispheres in deaf subjects may be due to sign language exposure and/or visual compensation for deafness.

References


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