

**Neural structural changes
associated with ritual glossolalia :
A morphometric study on the expertise of praying in tongues**

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We explored the structural neural correlates of glossolalia in a religious community. Glossolalia is a ritualistic prayer form, also known as ‘praying in tongues’ or ‘speaking in tongues’, striking for its production of semantically meaningless speech. As such, it provides a unique model of voluntary phoneme production in the absence of clear syntax and semantics, which thus need to be inhibited from their primary language by practitioners. In addition, glossolalia involves strong affective and spiritual components, which are considered intrinsic to this unusual verbal behavior. These characteristics make glossolalia a suitable subject to study its structural basis. Does regular glossolalia practice, akin to other verbal (e.g. bilingualism), spiritual (e.g. meditation) or procedural (e.g. juggling) behaviors, alter specific functional networks in the brain? We recruited 30 glossolalic Christians on which we performed MRI and DTI brain scans, and evaluated grey area volume masses (Voxel-Based Morphometry), cortical thickness calculations (Surface-Based Morphometry) and white matter tract analyses (Tract-Based Spatial Statistics) against three variables of interest: years, frequency, and duration of practice, as well as an index of glossolalic practice which was a function of all three variables multiplied. A new theoretical neurological model of glossolalia was developed to determine regions of interest (ROIs). Under strict confirmatory conditions, we were not able to find any significant correlations of our glossolalia index with any brain region both on a ROI-based level as well as on a whole-brain level. However, other variables of interest, and a less conservative significance threshold, allowed detecting several exploratory trends which we summarize in a conceptual model usable for future studies. In the grey matter, these trends consist of a negative association with the left Ventromedial Prefrontal Cortex, a positive one with the right Ventromedial Prefrontal Cortex, a negative effect in the left Inferior Frontal Gyrus, a positive one with the left Temporoparietal Junction, and a positive association with the right Superior Parietal Lobule. In the white matter, we found a positive association with the right Superior Longitudinal Fasciculus and the right Inferior Fronto-Occipital Fasciculus. These findings highlight the mundane nature of glossolalia, a behavior often depicted as extraordinary and even pathologized. On the contrary, we hypothesize that this ritualistic practice has grown across centuries and continents because it seamlessly and economically recruits regular neurofunctional networks already in place for other purposes.

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