## 8th BigBrain Workshop - Challenges of Multimodal Data Integration



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# Exploring the links between the localization of cortical areas and the variability of folding patterns

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#### Introduction

The variability of the cortical folding pattern is very complex. Hence, the links between folding and functional architecture have rarely been studied. To explore these links, we perform a stratification of the population according to the regional folding pattern before performing group analysis of functional maps [Sun et al., 2016]. To illustrate the potential of this strategy, we apply this approach to the study of the links between the shape of the precentral sulcus and fMRI-based proxies of areas 44 and 55b.

#### Material and methods

The 882 first HCP subjects (2015 release) were processed using the "Morphologist 2012" pipeline [http://brainvisa.info]. All brains were affinely normalized to the Talairach space. A group of seven sulci making up the Precentral Gyrus was formed for shape analysis. Pairwise shape similarity matrices were computed using rigid alignment. Isomap method was used to project the individual gyri into a low dimensional manifold. All gyri were also rigidly aligned to the most typical one, namely the gyrus with the minimum average distance to the set. Moving local average shapes were computed in this target space along each manifold dimension for visualization. The evolution of this moving average provides a detailed description of the shape-feature coded by the coordinates in the manifold. For each subject, a fMRI contrast used to define proxies of the language-associated areas 44 and 55b was transformed from the native space to the gyrus target space, in order to perform the same moving average process.

#### Results

Regarding the shape of the precentral sulcus, the first dimension of the manifold codes for the I-shape or Tshape of the inferior precentral sulcus. T-shapes are associated with larger proxies of the 44 area (see Fig.). The third dimension of the manifold codes for the length of the inferior precentral sulcus, and for the localization of the interruption usually separating the inferior precentral sulcus from the superior precentral sulcus. The 55b area is systematically located in this interruption, regardless of its localization (see Fig.).

### Conclusion

Using manifold learning to represent the variability of the cortical folding patterns requires large datasets beyond reach for post mortem architectonic mapping. This is why we propose to use fMRI-based area proxies to establish a hypothesis, which we will test in a second phase with the brains used to establish the Jülich Brain. Fourteen of these have recently been analyzed with the Morphologist pipeline [Wang et al., 2024].

#### References

Sun Z. Y. et al., "Linking morphological and functional variability in hand movement and silent reading". Brain Structure and Function 221(7):3361-71, 2016

Wang, X. et al. "A framework to improve the alignment of individual cytoarchitectonic maps of the Julich-Brain atlas using cortical folding landmarks." Cerebral Cortex 34.2 (2024): bhad538.

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