Normative modelling of cortical folding in term and preterm born neonates

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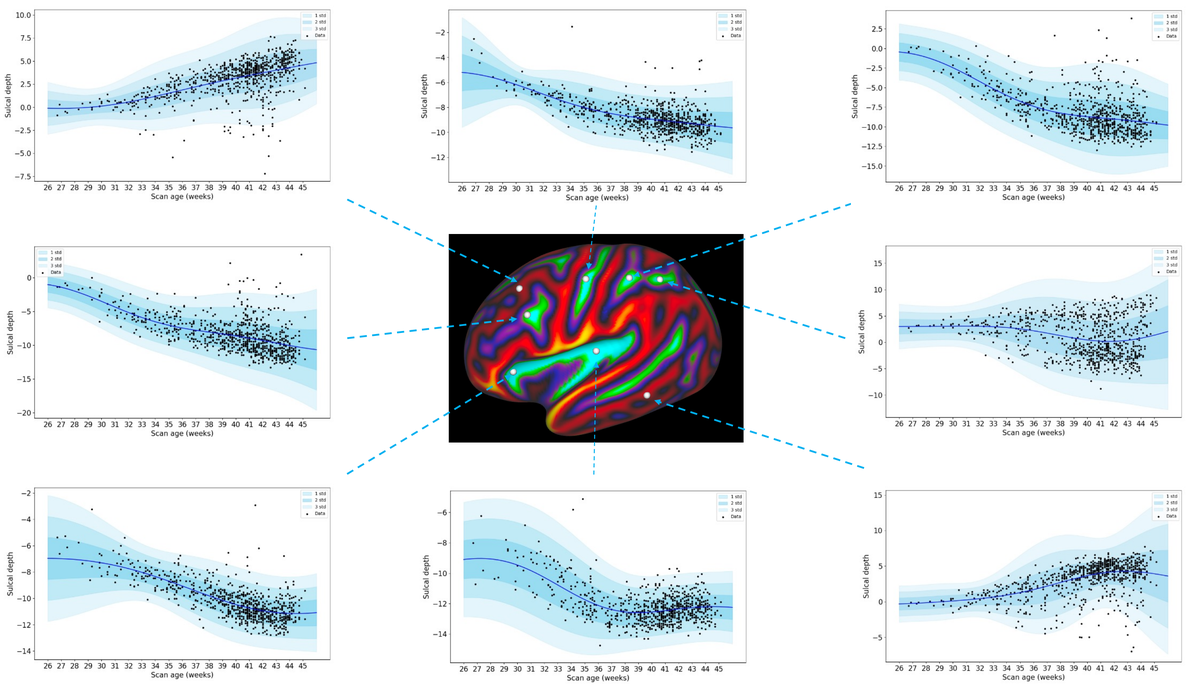
1. Summary

- **Outliers detected by normative models of the cortex are not necessarily related to pathology but may come from image registration errors.**

2. Motivation

- Normative models encode heterogeneity of the normative population as uncertainty in the model [1].
- For models of the cortex, uncertainty can be inflated due to errors in image registration, which occurs due to atypical folding variants

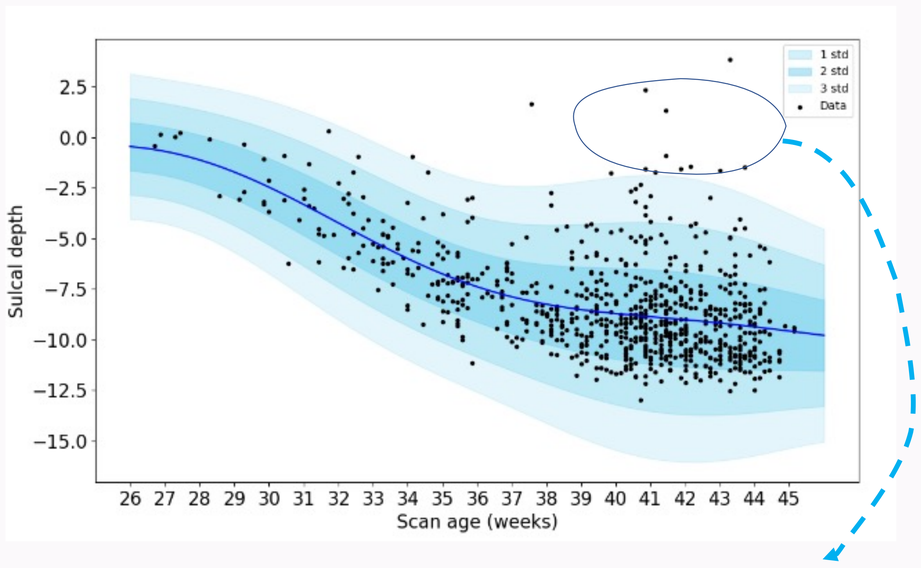
3.Method

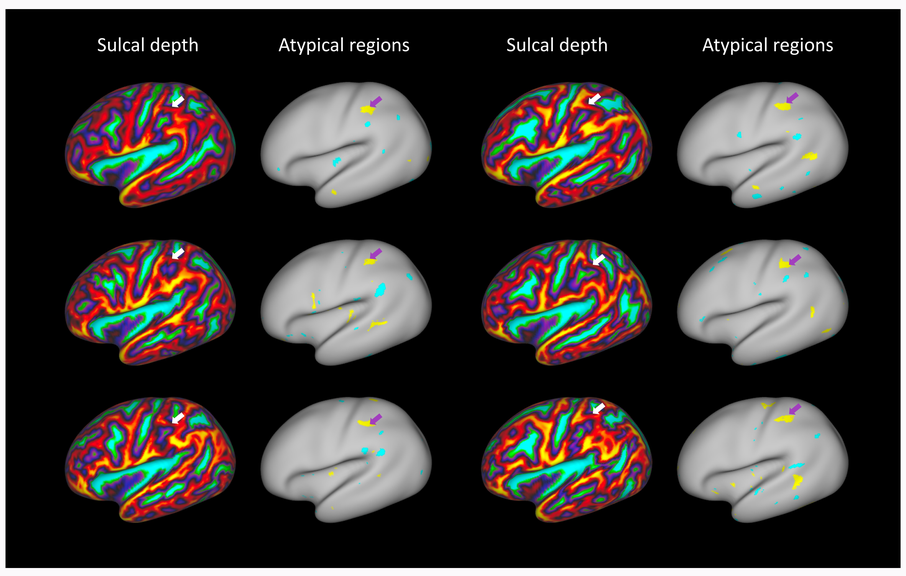


- Scans from 782 participants (mean PMA at scan ± standard deviation: 39.81±3.54, females: 360) from the developing Human Connectome Project (dHCP) were used as input for normative modelling. All individuals were scanned shortly after birth.
- Approximate Gaussian process regression models of sulcal depth across PMA were fit at each vertex of the population average cortical surface mesh.

4. Result

- **Uncertainty of the model increases with PMA** as cortical folding develops; this reflects an inability of classical image registration algorithm to perfectly align patterns of folding across individuals.
- Vertices tended to reflect **two trends of sulcal depth development** from 26 weeks to 46 weeks: increasing for gyri and decreasing for sulci.
- **Outliers** were typically caused by anatomical variants such as branching, splitting and existence of extra folds.





- Figure below shows estimated mean vertex-wise sulcal depth changes over age. MAE between the real and predicted sulcation is shown in the bottom right indicating areas with marked developmental changes.

5. Reference

Marquand, Andre F., et al., Conceptualizing Mental Disorders as Deviations from Normative Functioning.