

Differential Patterns of Cortical Expansion in Fetal and Preterm Brain Development

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Background

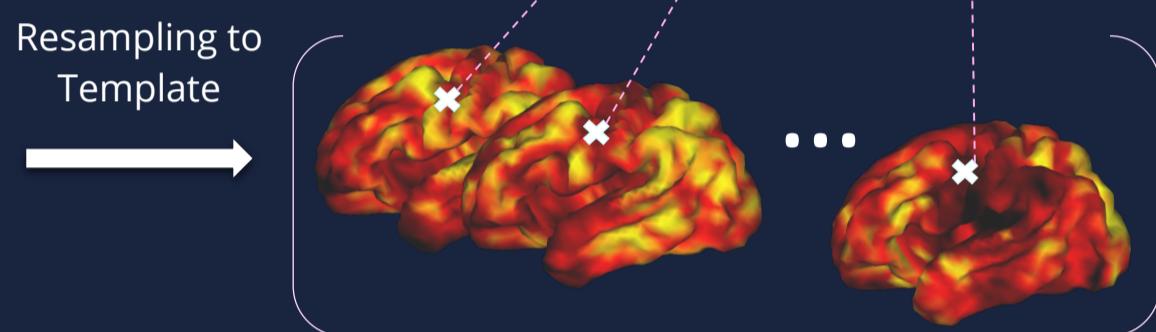
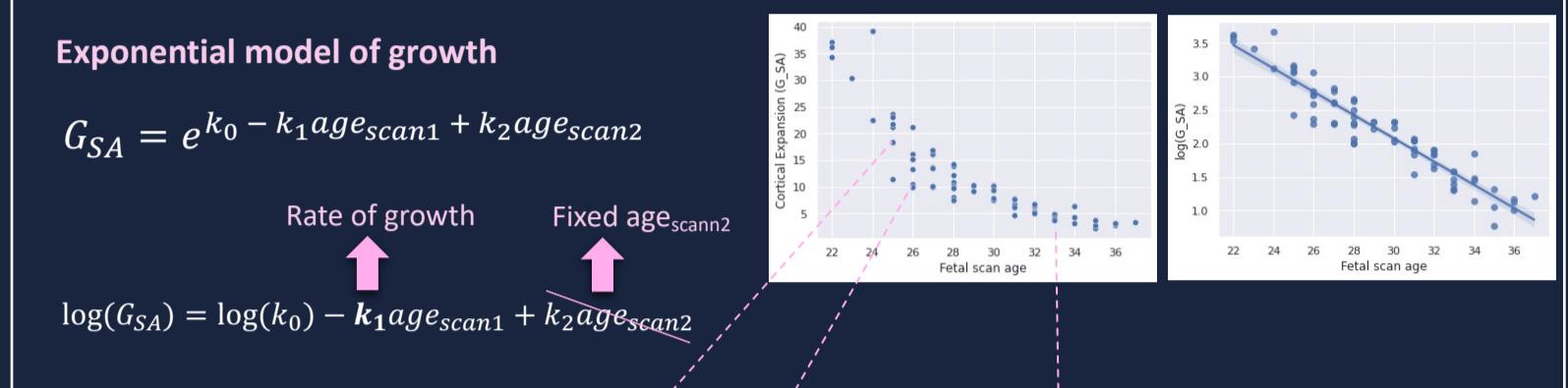
- Most in-vivo studies of cortical development have used:
 - longitudinal data following **preterm** birth, or
 - fetal cross-sectional data** only and analysis based on specific ROIs

Summary

- We estimate **vertex-wise patterns** of cortical expansion from longitudinal surface data from **22 to 44 weeks PMA**:
 - 72 subjects scanned in utero and after full-term birth
 - 90 preterm subjects, scanned twice after birth

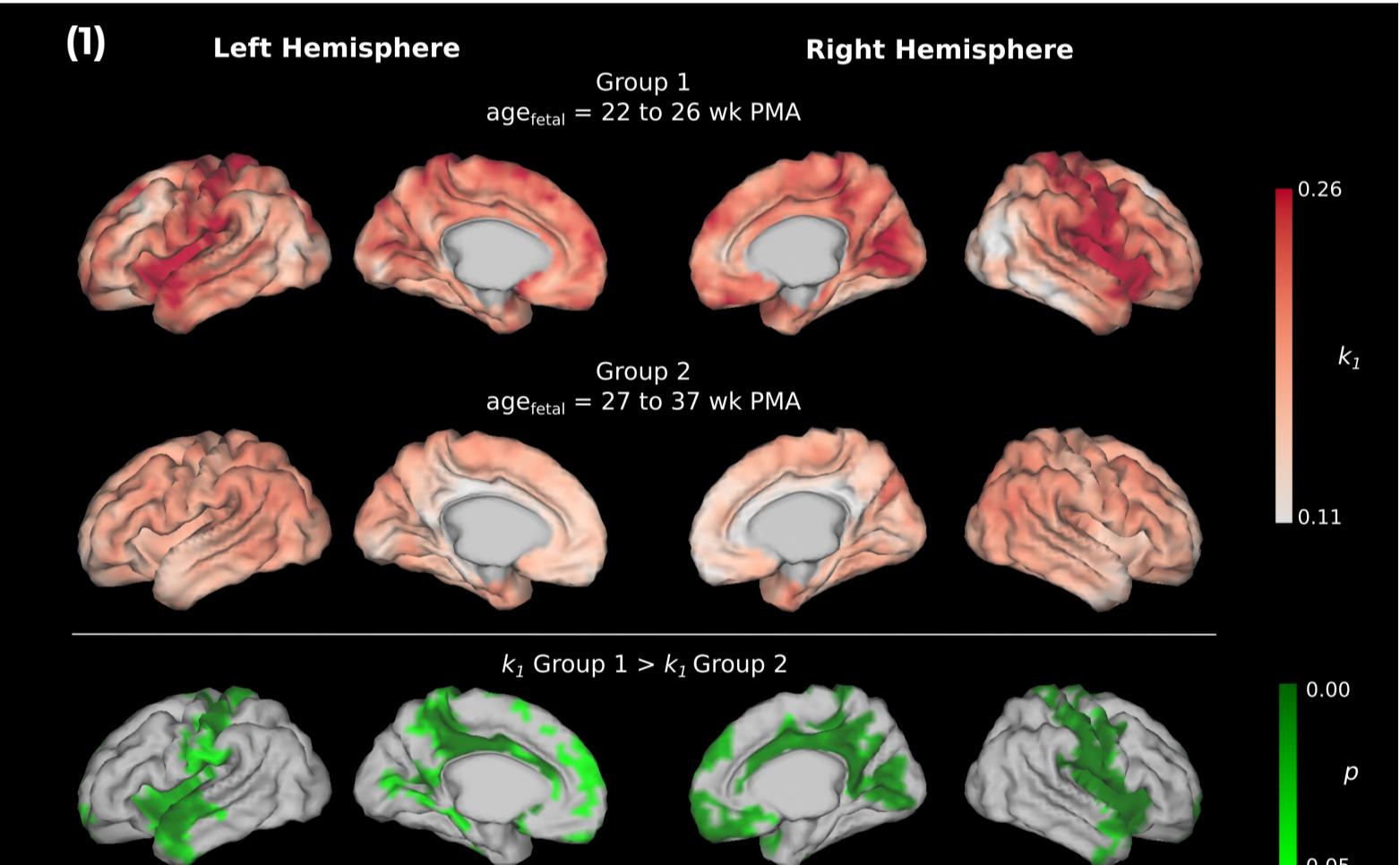
Methods

- Biomechanically Constrained Surface Matching was used for longitudinal registration of pairs of surfaces
- Estimated cortical expansion maps were resampled to template space and analysed using



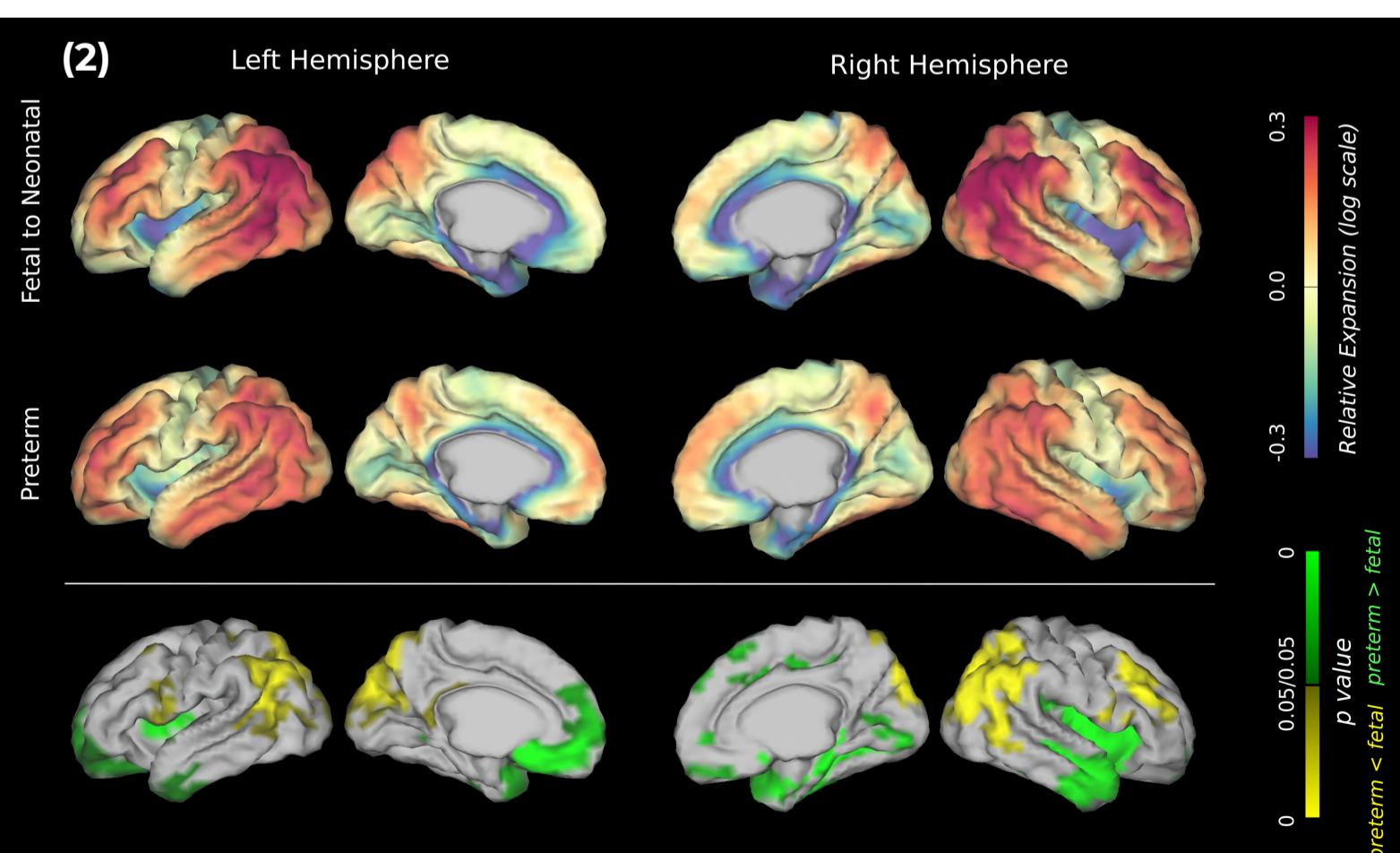
(1) Cortical expansion rates vary with age in healthy fetal development

- Comparison between 2 groups based on age at 1st scan reveals growth rates are higher in the younger period for regions around the **central sulcus** and **insula**.
- Coincides with the development of **primary and secondary folding** in these areas.



(2) Fetal and preterm cortical expansion exhibit different regional patterns

- Global cortical growth did not differ significantly between the preterm and fetal datasets.
- Preterm neonates exhibit higher **relative expansion** in the **temporal and frontal poles** and insula, while fetal relative expansion was higher for the **posterior lateral parietal cortex**.



Conclusions & Future Work

- Biomechanically constrained longitudinal surface registration can **reveal patterns of cortical expansion not captured by ROI-based studies**.
- Future work will explore the use of **non-linear modelling** for analysis of growth patterns.

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