Relating Cerebral Blood Flow to Structural & Functional Metrics in Typically Developing Children

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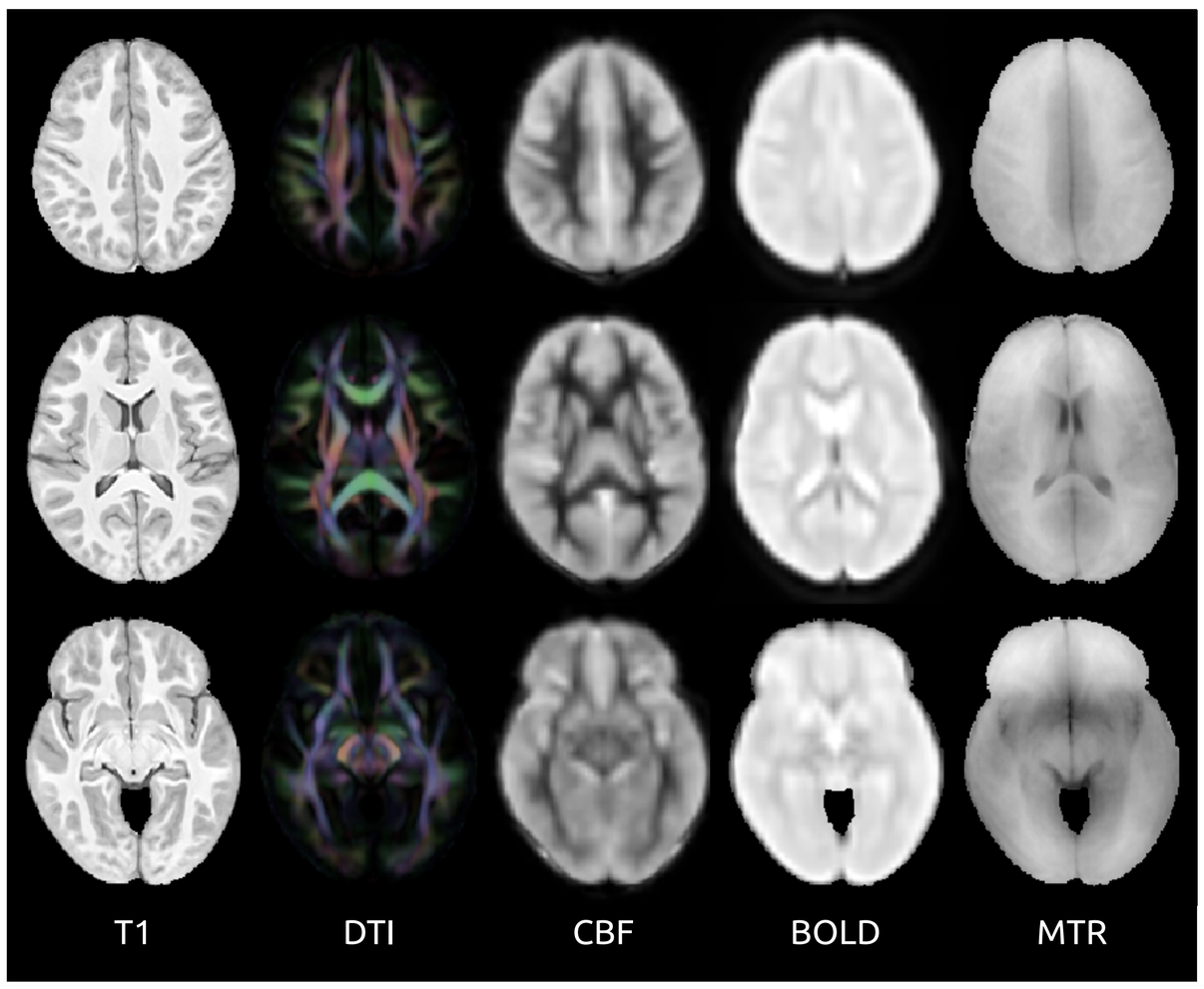
Overview

- 88 normally developing children aged 7-17 years were imaged with both structural and functional modalities:
  - Pseudo continuous arterial spin labeled MRI
  - T1
  - Diffusion tensor MRI
  - Magnetization transfer
  - Resting state BOLD fMRI
- A multivariate population-averaged template was created with ANTs [1]
- Regularized canonical correlation analysis was used to identify the relationship between cerebral blood flow and:
  - Cortical thickness
  - Fractional anisotropy
  - Magnetization transfer ratio
  - Mean resting state BOLD response

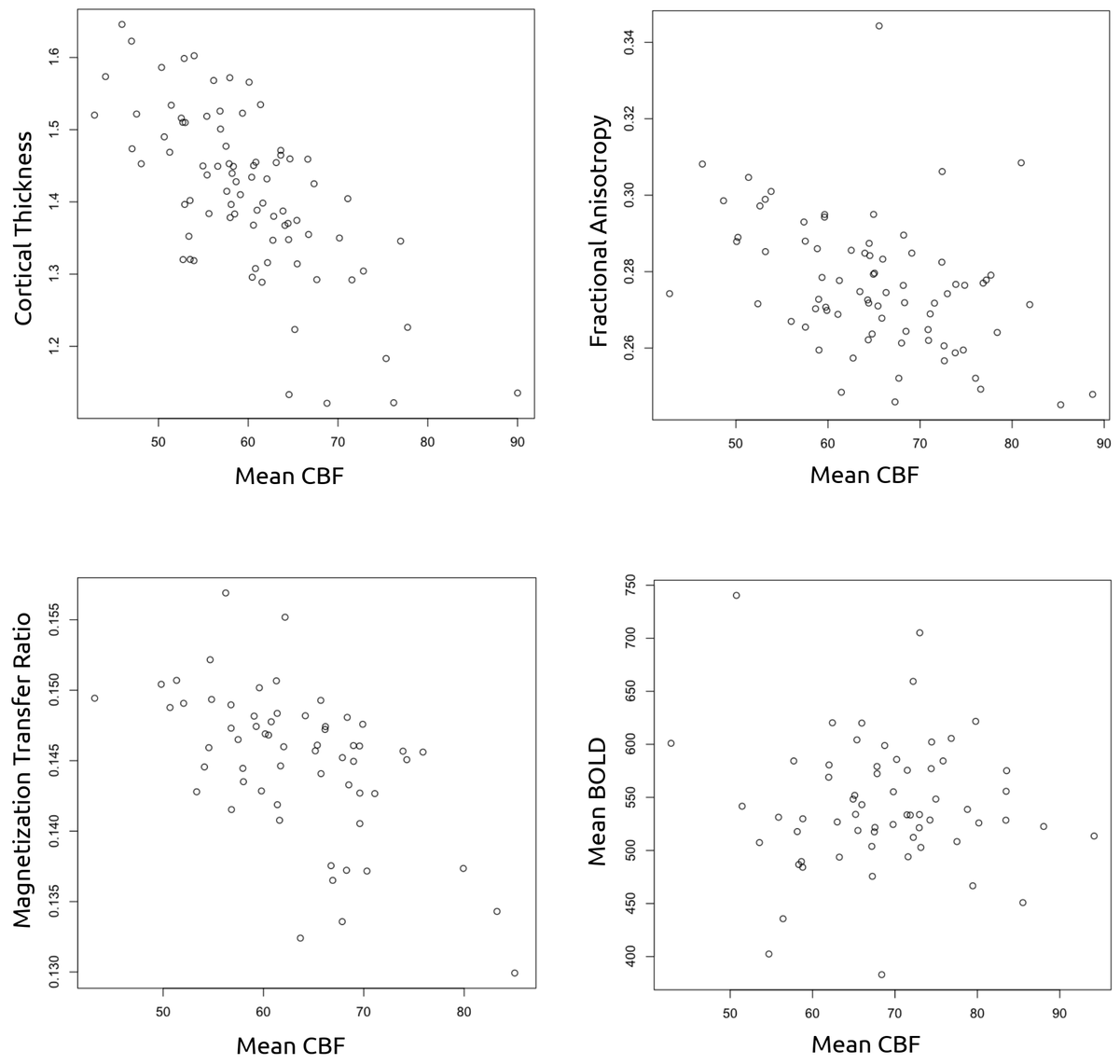


Atlas Creation

- For each modality, a custom template is created using the ANTs toolkit [1]
- Each modality-specific template is then aligned to the T1 template to create a single multivariate template-space
- The multivariate template is brain masked and used as a basis for brain masking all modalities for all subjects
- Intra-subject inter-modality registration aligns all modalities to the T1 space for each individual
- Final subject-to-template alignment is achieved by registering subject-T1 to template-T1

Statistical Comparison

- 3-Tissue segmentation was performed using the Atropos tool [1]
- CBF, cortical thickness, and mean BOLD are measured in gray matter
- FA and MTR are measured in white matter
- Regularized canonical correlation is used to examine the pair-wise relationship between CBF and each of the other metrics [2]
- Canonical weights are used to calculate a weighted average for each modality



Whole brain weighted average values are plotted using the results obtained from each pair-wise comparison. The relationship between cortical thickness and Mean CBF (R^2=0.4777) was the strongest of the metrics examined. In white matter, the MTR (R^2=0.3126) was stronger than FA (R^2=0.1462). The mean BOLD (R^2=0.1414) metric was the weakest.

References

1. Advanced Normalization Tools (ANTs). http://www.picsl.upenn.edu/ants
2. Avants, et. al. Dementia induces correlated reductions in white matter integrity and cortical thickness: A multivariate neuroimaging study with sparse canonical correlation analysis. NeuroImage 50 (2010). 1004-1016.