

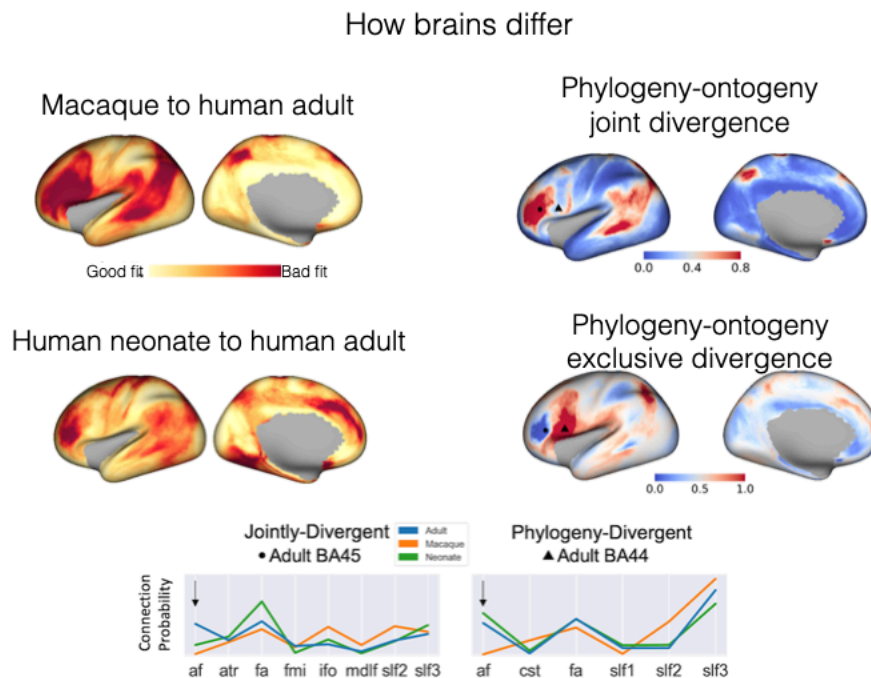
MSc Project 1: What's special about the human brain? Comparing brain organization across species using MRI

What makes a brain unique? Primates have large, complex brains that underlie a unique repertoire of behaviors. However, how brain differ between primates and how that relates to their behavioural abilities is large unknown. Until recently, most comparison were simply done on the basis of brain size, ignoring the internal organization of the brain. Recently, the advance of neuroimaging techniques in evolutionary biology has changed this. In our lab, we scan the (post-mortem) brains of a wide range of primate species to map out the white matter connections between brains areas—the so-called 'connectome'. We develop techniques to compare these connectomes across species, so we can identify which parts of the brains are similar and which are unique to any given species. Together, this is the first 'big data' approach to understand not just any single brain, but the patterns of brain evolution across the entire primate order.

The student can enrol in a number of research projects, depending on their interests. Some ongoing projects are:

1. Development of techniques to compare brain organization across species

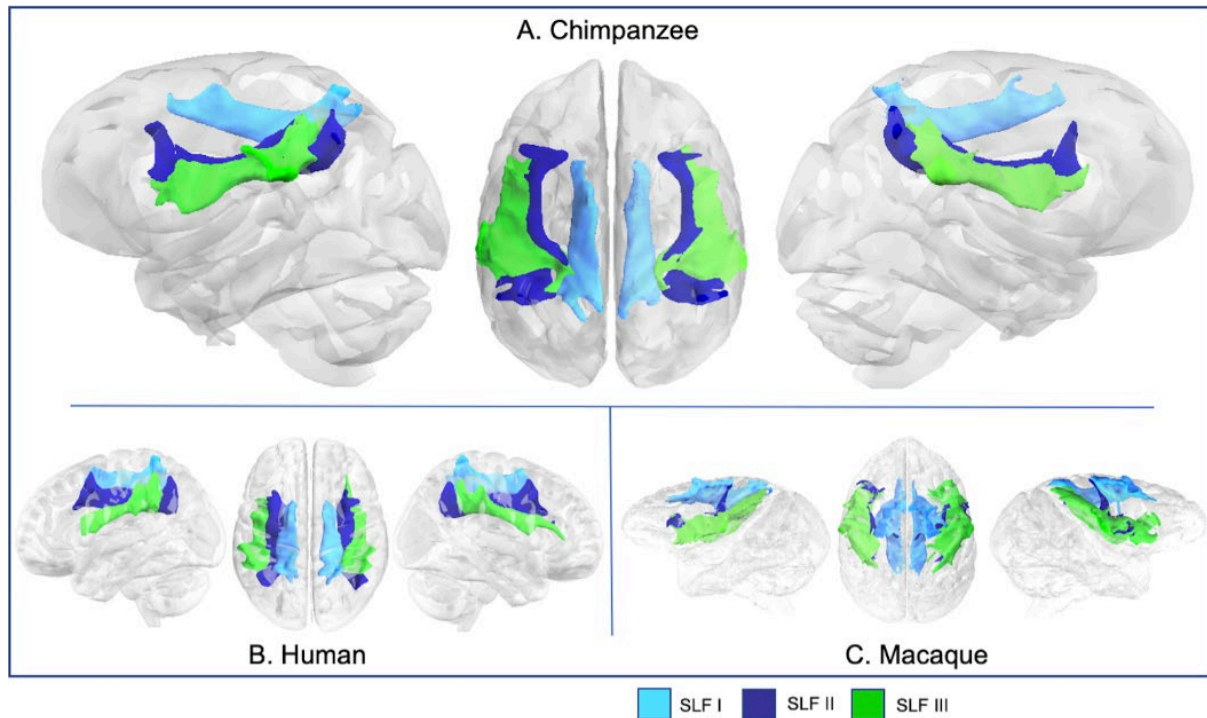
This project allow a more technically minded student to contribute to our approach to describe brain organization in terms of abstract spaces. Two brain might differ in many respects, such as size, sulcal pattern, neuron types, and connections. Some of these are relevant to understanding differences in the abilities of the brains (such as neuron types and connections), while other are not (such as size and sulcal patterns). We have developed a way to 'abstract away' from the irrelevant features into a common space that allows us to directly compare even very diverse brains. The student will be able to help further develop these techniques.



Relevant literature: (1) Mars et al., 2018, eLife, doi: 10.7554/eLife.35237; (2) Mars et al, 2018, TICS, doi: 10.1016/j.tics.2018.08.009; (3) Eichert et al., 2020, eLife 9:e53232, doi:10.7554/eLife.53232

2. Creating a map of a new primate species' brain

A number of ongoing projects involve investigating the organization of currently unstudied primate brains. This is a unique opportunity to investigate a new species for the first time. We have developed a number of tools for this purpose and have built up a database of primate scans that can be explored by a student. New species include the gorilla, gibbon, tamarin monkey, and bush baby. For those interested, a comparison between primate and non-primate brains is also possible.



Relevant literature: (1) Bryant et al., 2020, PLoS Biol 18:3000971, doi:10.1371/journal.pbio.3000971; (2) Vijayakumar et al., 2018, Brain Struct Funct, doi: 10.1007/s00429-018-1791-1; (3) Neubert et al., 2014, Neuron, doi: 10.1016/j.neuron.2013.11.012

Potential students are welcome to contact the primary supervisor (rogier.mars@donders.ru.nl) to see further work ongoing in the lab.