Characterizing modularity in healthy ageing

Motivation and objective

- Development of the brain is characterized by the formation of neural connections among various regions and regions starting to work together as modules. There also exists a reverse process that starts to set in during the early older age where the death of neurons and the concomitant changes in the structural connectivity result in changes in the function of the brain.
- In this project, we look at the whole span from development to ageing together holistically. We hypothesize that the developmental and ageing trajectories of the brain are mirror reversal of each other.
- *We will be using graph theoretic measures related to segregation and integration of the brain function and investigate the similarities and differences across the lifespan*

Datasets

- http://umcd.humanconnectomeproject.org/umcd/default/index - 164 participants
- Resting state functional MRI data is used for this study.
- NKI Rockland Sample – updated participants – 581 participants
- The dataset is divided into 2 main subgroups:
  - Including developing brain – where the min age is 7
  - Excluding the developing brain – where the min age is 19

Preprocessing of NKI dataset

- The data was preprocessed using FSL, by performing the following steps: *Slice time correction, motion correction, brain extraction, smoothing using the 8 mm gaussian kernel, registration to the subjects' T1-w data, conversion in MNI space (standard space) and generating functional connectivity matrix.*
- Data was also filtered based on the extent to which motion correction was required, based on visual inspection of the variation FD through the scan. A threshold FD value of 0.5mm was followed.

Method

- The dataset is split into age bins and a representative FC is calculated for each bin
- Each age bin is represented as a layer in a multilayer network
- Now the modularity is calculated for each layer using a multilayer modularity maximization algorithm that accounts for the dependence between the layers.
- The flexibility and the participation coefficient is also calculated to observe the effect at a nodal level
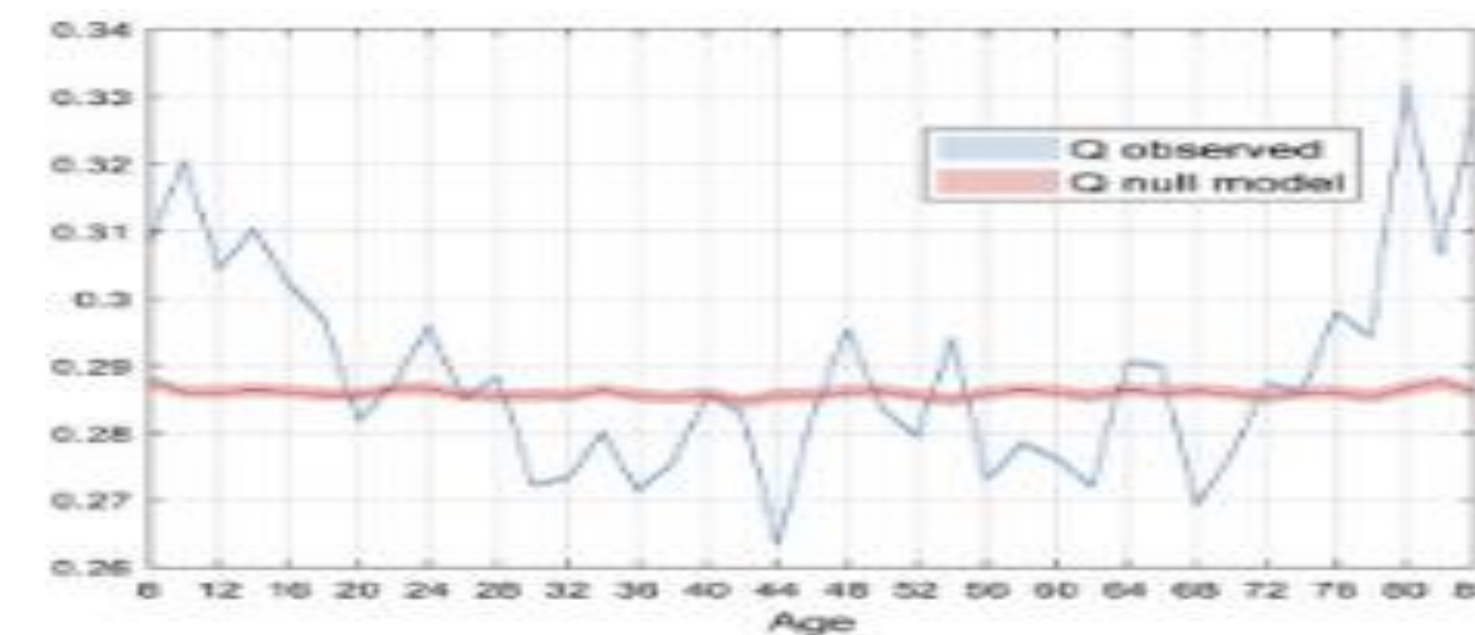
Future Directions

- How does this trend changes in the case of dynamic functional connectivity?
  - Especially in the context of how modularity and flexibility are related.

The trend in modularity across age groups based on functional connectivity (rs-fMRI)
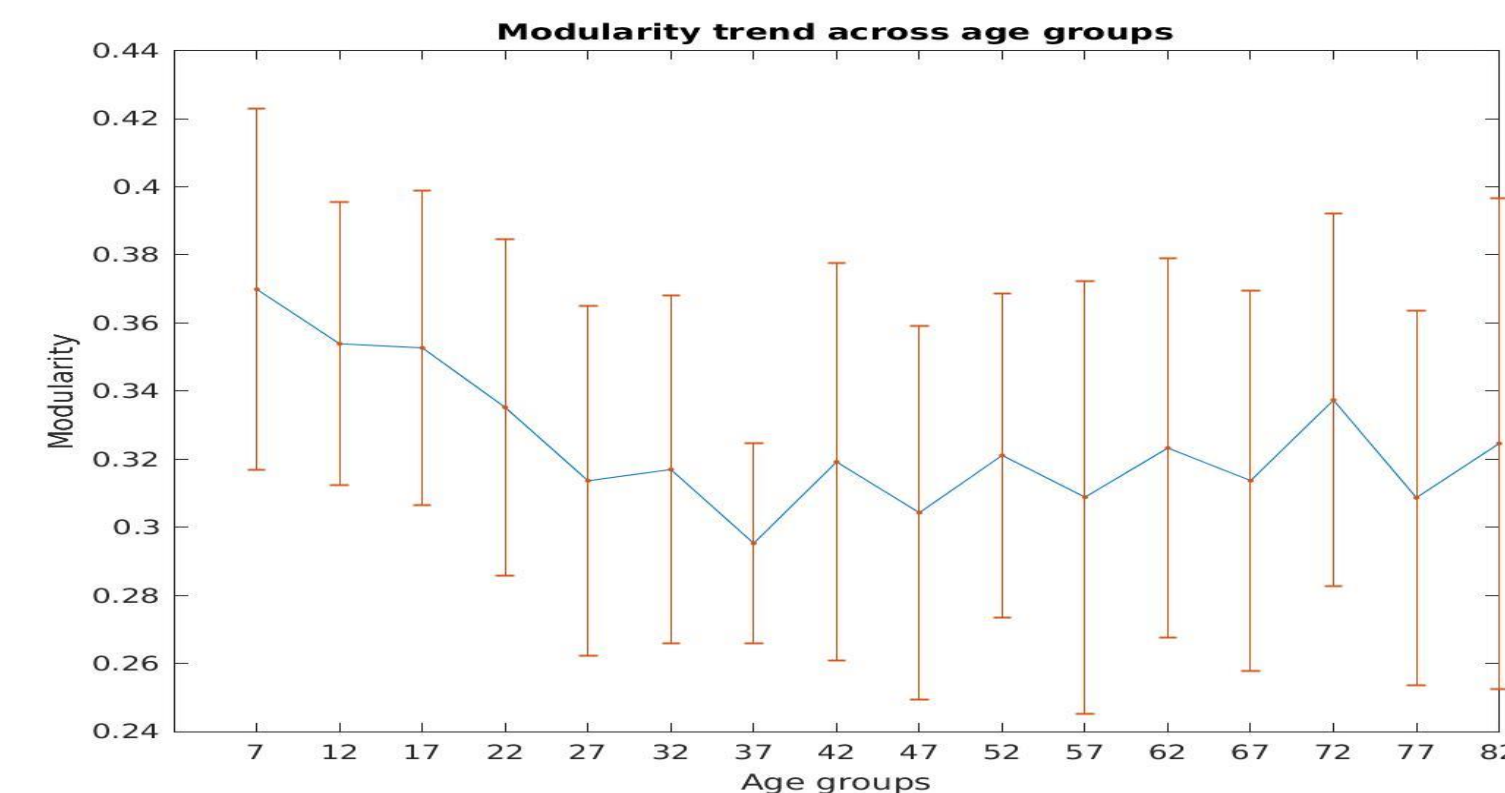
The modularity trend in across age groups based on the structural connectivity (DTI)

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