Introduction

Multiple sclerosis (MS)
- Neurodegenerative autoimmune disease
- Immune system targets central nervous system (CNS)
- White blood cells enter the CNS, produce destructive inflammation
- Triggered chemical responses lead to lesion formation, disruption of structural and functional connections between brain regions
- Axonal disruption believed to lead to grey matter cell death (atrophy) via Wallerian degeneration (WD)

Aim

The goal of our research is -
- To derive connectomics data from MRI of MS
- To analyze the brain as a network, measuring connection and lesion based disconnection of regions
- Leverage neuropsychological data to investigate the impact of lesions and atrophy on cognition and personality

Methods and Results

Methods and Results (cont’d)

Probabilistic Tractography
- Map water diffusion through probabilistic path illustrating white matter tracts connecting regions
- Generate structural connectivity matrices in DSI Studio

Figure 3: Mapped connectome via probabilistic tractography

Functional Connectome
- Established resting state functional networks are template for expected resting state activation patterns
- De-noise based on these expected activation patterns
- Generate functional connectivity matrices from de-noised data, representing correlation of activity between brain regions across time
- Matrices describe functional connectivity of networks disrupted by disease pathology

Network Based Statistical Analysis
- Employ dis-connectome matrices from the NeMo tool
- Generate weighted connectome matrices where disconnection from lesions of different types contribute according to the amount white matter damage inflicted
- Perform network based statistical analyses with neuropsychological measures accounting for statistical controls
- Identifies brain regions which are significantly associated with the neuropsychological outcomes of interest

Figure 4: Damage to occipital network found significantly associated with lower SDMT scores in people with MS

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Figure A: neque...