

Changes in functional connectivity in the recovering severely injured brain

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INTRODUCTION

Assessing resting state functional connectivity of the BOLD signal in the brain is a topic of wide interest and potentially significant clinical implications. Here we apply techniques of seed based correlations to longitudinally evaluate and contrast changes in the resting state fMRI networks of 2 patients recovering from severe brain injury. To address these problems we focus on the use of longitudinal studies within individual patients to allow calculations to be done within each subjects brain space.

METHODS

1. Seed Correlation Analysis of rs-fMRI
Subjects were scanned in a 3T GE scanner at rest. Data was analyzed using AFNI and FSL. 4mm spheres were used as seeds; default mode network: PCC, MPF, L (Fox et al, PNAS, 2005); attention & working memory: rFEF (Corbetta et al, J Cog Neuroscience, 2002); auditory, visual, sensorimotor: (van de Ven et al, HBM, 2004); language: Broca's (Koyama MS et al., J. NeuroSci., 2011); central thalamus (Metzer et al, Frontiers in Neuro, 2010); rostral striatum (Harrison et al, Arch Gen Psychiatry, 2009).

3. Test-Retest of Networks

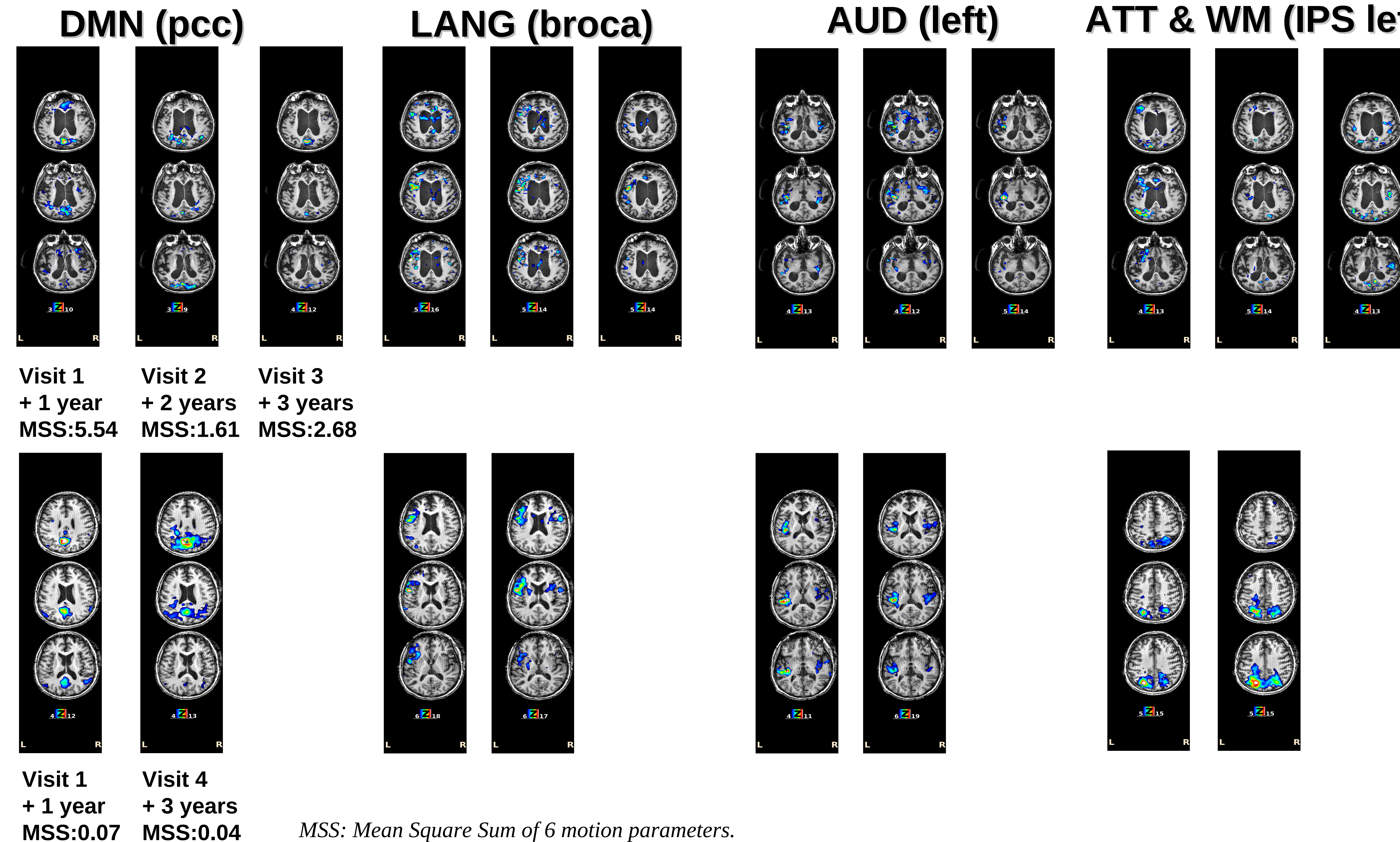
Intra Class Correlation (ICC) (Thomason et al., NeuroImage, 2011)
Percent Overlap of Activation (OA) (Maitra, NeuroImage, 2010)

Patient 1 (57 yo female)

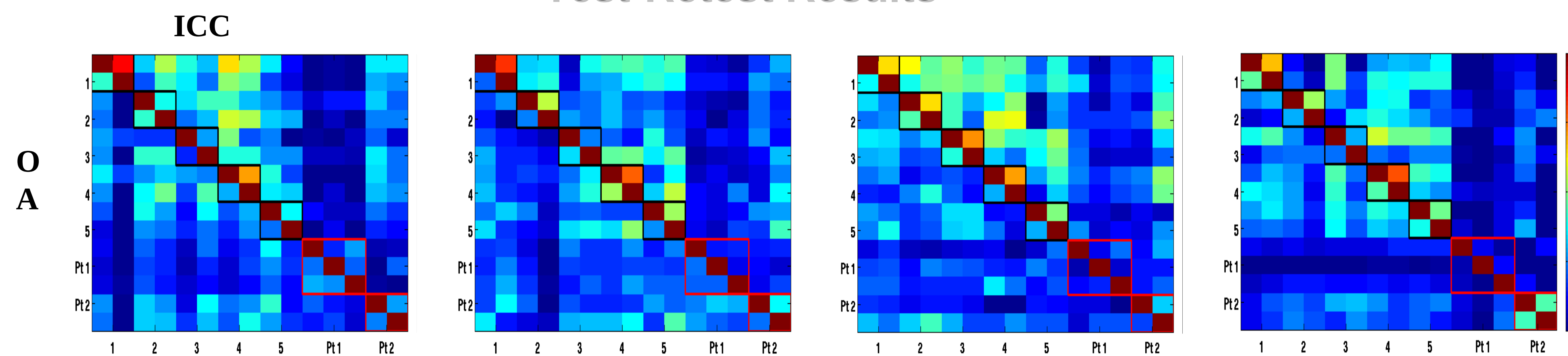
- Hypoxic ischemic encephalopathy, secondary to diffuse fat emboli
- Initially unresponsive with visual tracking (Visit 1)
- Recovers fluent speech and elements of executive function by Visit 2.

Patient 2 (22 yo female)

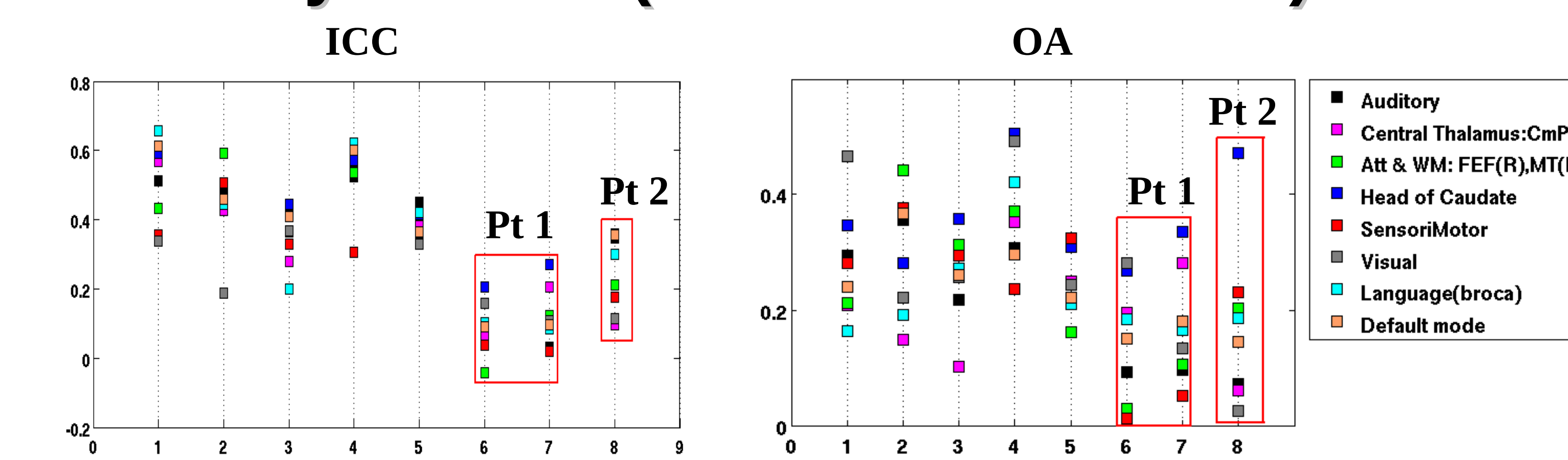
- Stroke due to basilar artery occlusion with brainstem infarct.
- Preserved cortex; bilateral infarcts of CT, ventral and tegmental pons & midbrain; Infarct of R LGN
- Opens L eye only, inconsistent eye-movements to command; intermittent communication with eye movements.



Test-Retest Results

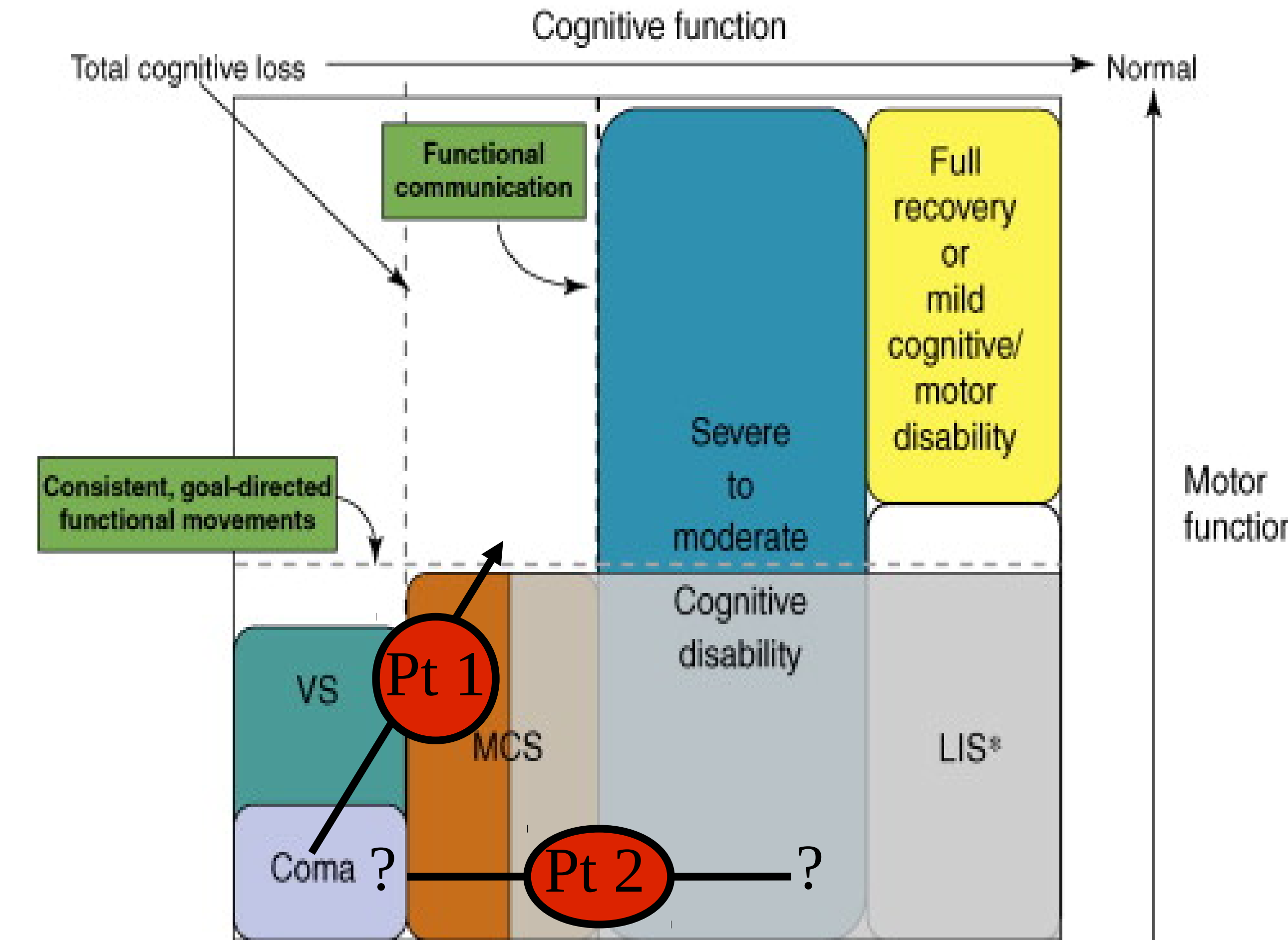


Summary Results (across all networks)



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Behavioral & Clinical Assessment



Schiff, N.D.(2010) Recovery of consciousness after brain injury: Total motor loss a mesocircuit hypothesis. Trends in Neurosciences. 33(1). 1-9 TRENDS in Neurosciences

SUMMARY & CONCLUSIONS

- **Patient 1:**
 - Late (> 1 year) improvements in clinical status
 - Low-level Minimally Conscious State (CRS-R: 14) to mid range Confusional State (CRS-R: 22)
 - Clinical change and broad increases in cerebral metabolism (see Thengone et. al Poster: 675.08 Patient 2). Language processing using fMRI also established.
 - Variability in all networks, and networks do not resemble normals. Central thalamic, striatal and attention networks are slightly more stable over time.
 - **Patient 2:**
 - Language activation and fMRI communication has been established (Bardin JC et.al, Brain, 2011; Bardin JC et.al., Archives of Neurology, in press)
 - Closer to normals on some networks
- Conclusions:**
- Difference in findings between patients might reflect underlying integrity of structural networks.
 - Effect of motion (patient 1) needs to be considered and evaluated in other patients with similar profile.

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