

Lateralization of Word Reading fMRI Activation and DTI Structural Connectivity: Implications for Temporal Lobe Epilepsy

Introduction

- Language processes are typically more dominant in the left hemisphere (Springer et al., 1999)
- In left temporal lobe epilepsy (ITLE) cases, language lateralization is frequently atypical (bilateral/right lateralization; Goldman & Golby, 2005)
- If TLE encourages functional reorganization, then in overt word reading regions (such as Broca's Area and the Fusiform Gyrus) and connections (uncinate fasciculus, UF; inferior fronto-occipital fasciculus, IFOF; and inferior longitudinal fasciculus, ILF), ITLE patients should be less left lateralized than right TLE (rTLE) patients or healthy controls, and the opposite effect should be observed in rTLE patients

Method

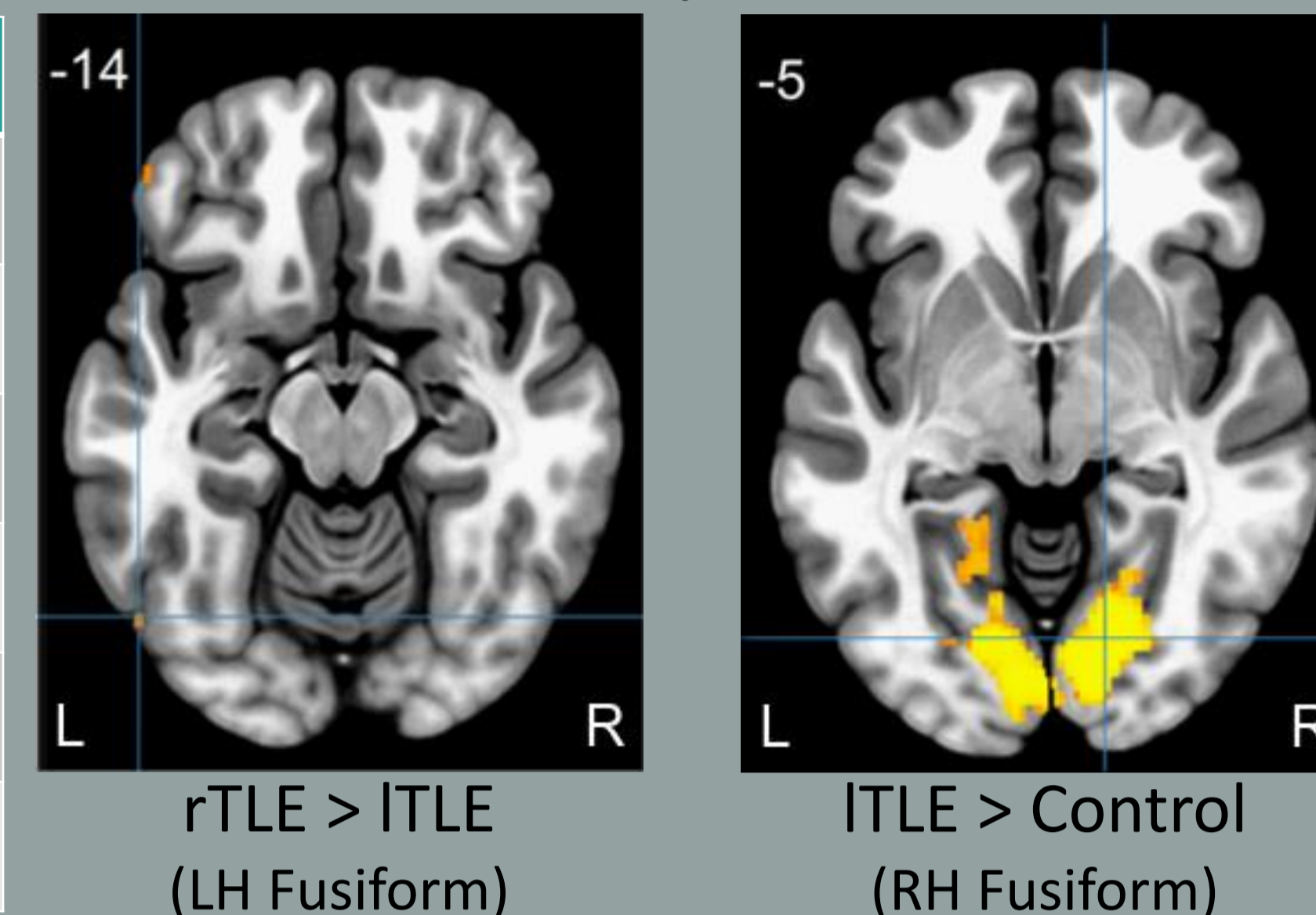
- 14 ITLE, 8 rTLE, 14 Control
- fMRI Exception Word reading (cannot be sounded out, e.g. yacht, N=25)
- Regions of Interest (from Freesurfer):
 - Broca's Area, Fusiform Gyrus
- Laterality Measure: tLI (t-score Laterality Index) =
$$\frac{\bar{X}_{RH} - \bar{X}_{LH}}{S_p \cdot \sqrt{\frac{1}{nvox_{RH}} + \frac{1}{nvox_{LH}}}}$$
- FSL *feat* for group analysis
- **Network Based Statistic (NBS;** Zalesky et al., 2010) with diffusion tensor imaging (DTI) data identified network component differing between groups
- **Multivariate Distance Matrix Regression (MDMR;** Shehzad et al., 2014) identified voxels with group dependent DTI connectivity profiles

Results

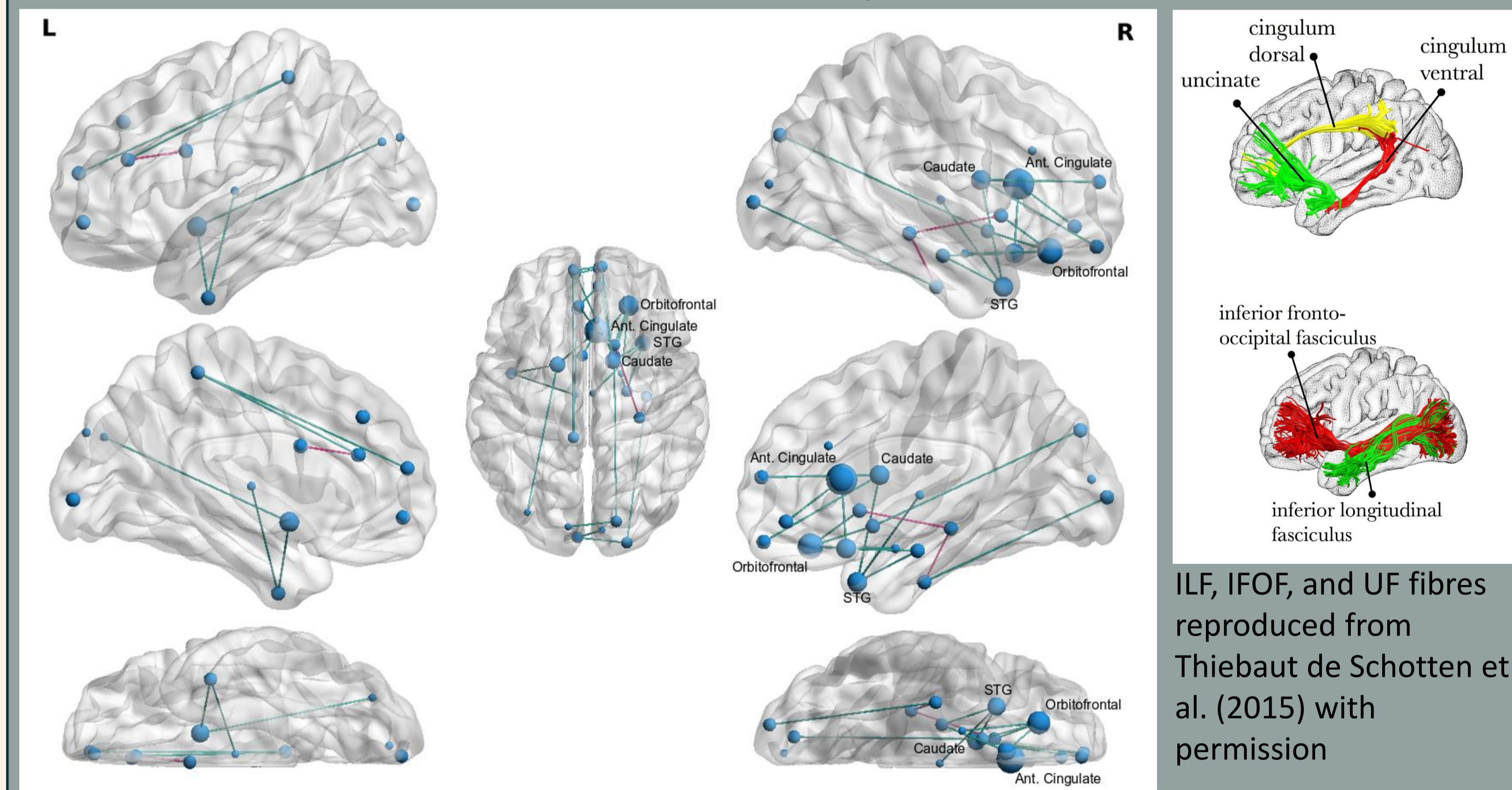
fMRI Laterality Comparison

Comparison	Region	t-value	df	p
rTLE - ITLE	Broca's	-1.308	20	.206
	Fusiform	-2.134*	20	.045
ITLE - Control	Broca's	-.0426	26	.674
	Fusiform	1.984~	26	.058
rTLE - Control	Broca's	-2.151*	20	.044
	Fusiform	-0.411	20	.686

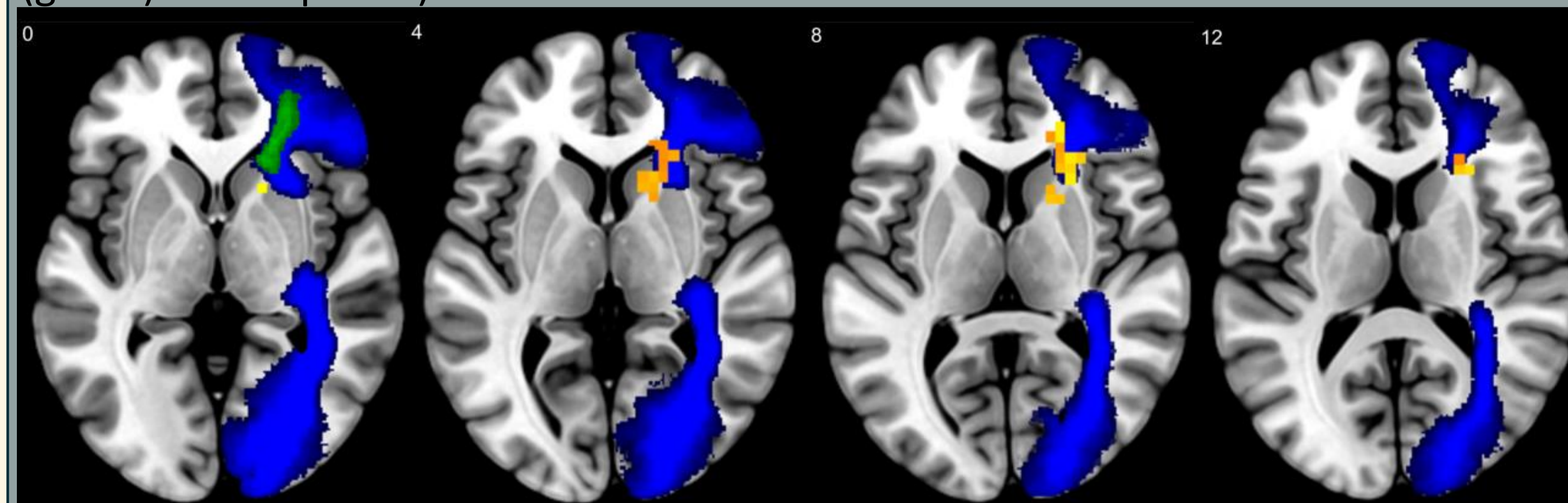
fMRI Group Contrasts



NBS identified DTI structural connectivity network exhibiting significant difference between ITLE and rTLE patients (green → ITLE > rTLE streamlines, red → rTLE > ITLE streamlines)



MDMR identified regions in yellow/orange exhibiting a patient group dependent distance between rTLE and ITLE patients' connectivity profiles (IFOF (blue) and UF (green) also depicted)



Discussion

- **fMRI:**
- rTLEs were more left lateralized than controls in Broca's area
- ITLEs were more bilateral or right-lateralized than controls and rTLEs in the fusiform gyrus
- **DTI NBS:** Connections of the UF, IFOF, and ILF had more DTI streamlines in ITLE than rTLE patients in the right hemisphere (RH)
- **DTI MDMR:** Voxels in the path of the RH IFOF had DTI connectivity profiles that differed across patient groups
- **Conclusion:** fMRI and DTI highlighted differences in language related activation and connectivity consistent with theories of functional and structural reorganization due to TLE

References & Acknowledgements

- Goldman, R.E. & Golby, A.J. (2005). Atypical language representation in epilepsy: Implications for injury-induced reorganization of brain function. *Epilepsy Behaviour*, 6.
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