Intrinsic connectivity as a means to differentiate patients with disorders of consciousness

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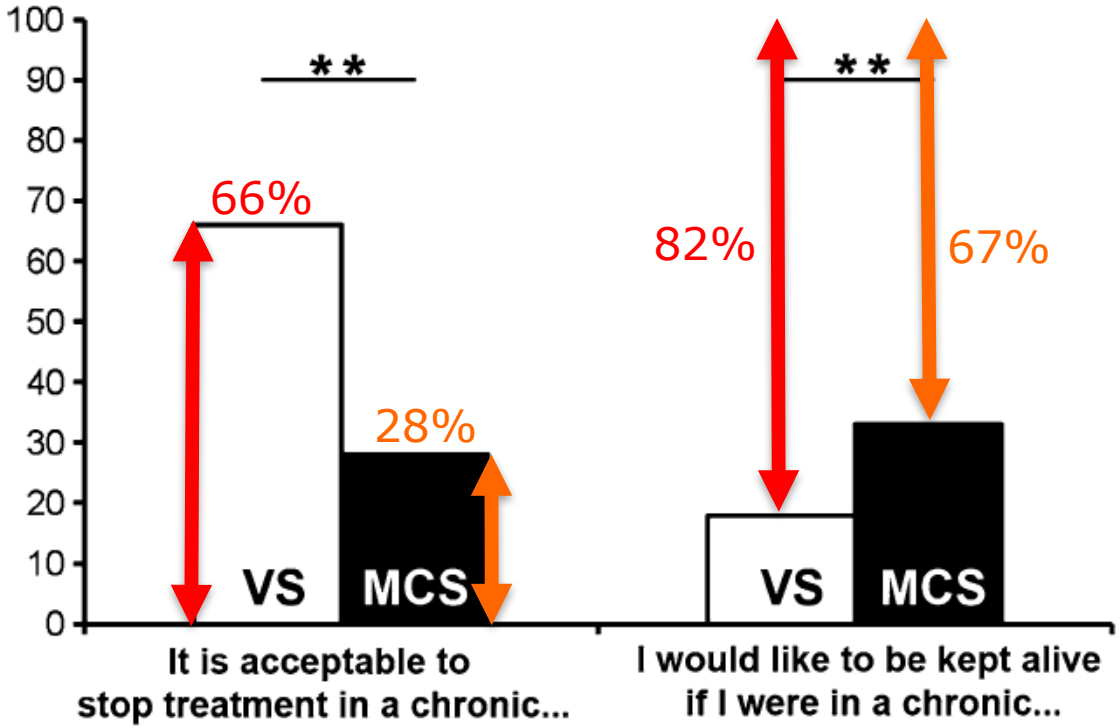
A clinical-ethical imperative

Attitudes towards end-of-life issues in disorders of consciousness: a European survey

A. Demertzi · D. Ledoux · M.-A. Bruno · A. Vanhaudenhuyse · O. Gosseries · A. Soddu · C. Schnakers · G. Moonen · S. Laureys

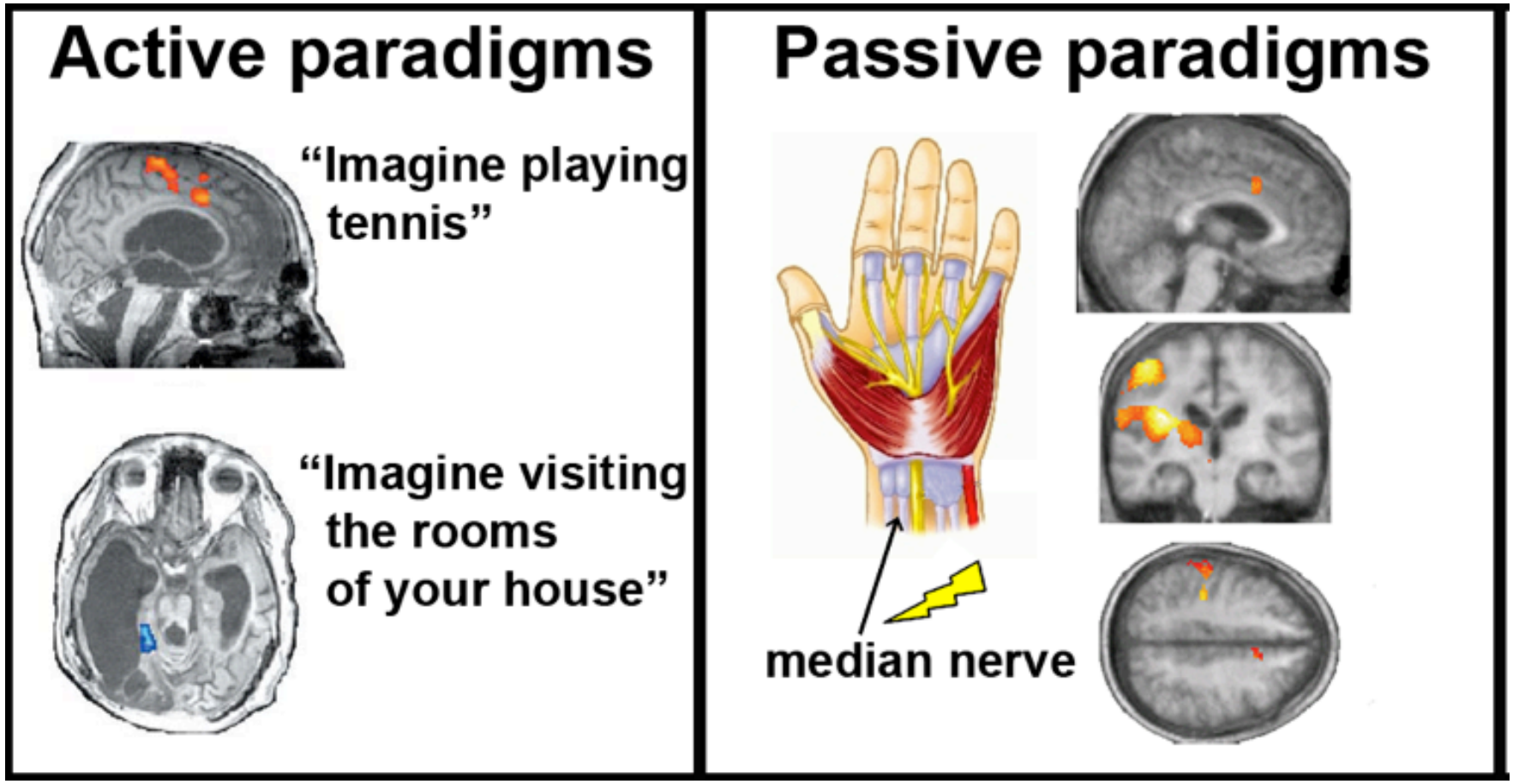
European Neurological Society

2,475 medical professionals



Demertzi et al, J Neurol 2011
Demertzi et al, Prog Brain Res 2009; Neuroethics 2013; Br Injury 2014

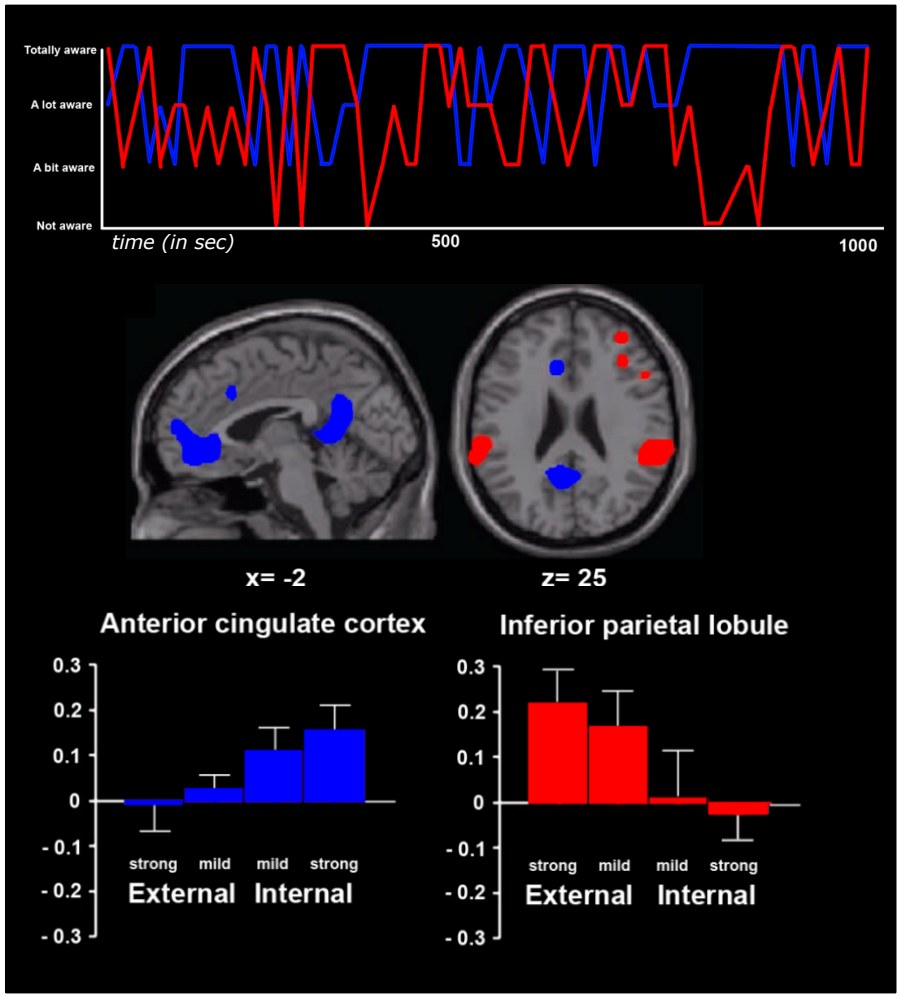
Neuroimaging paradigms

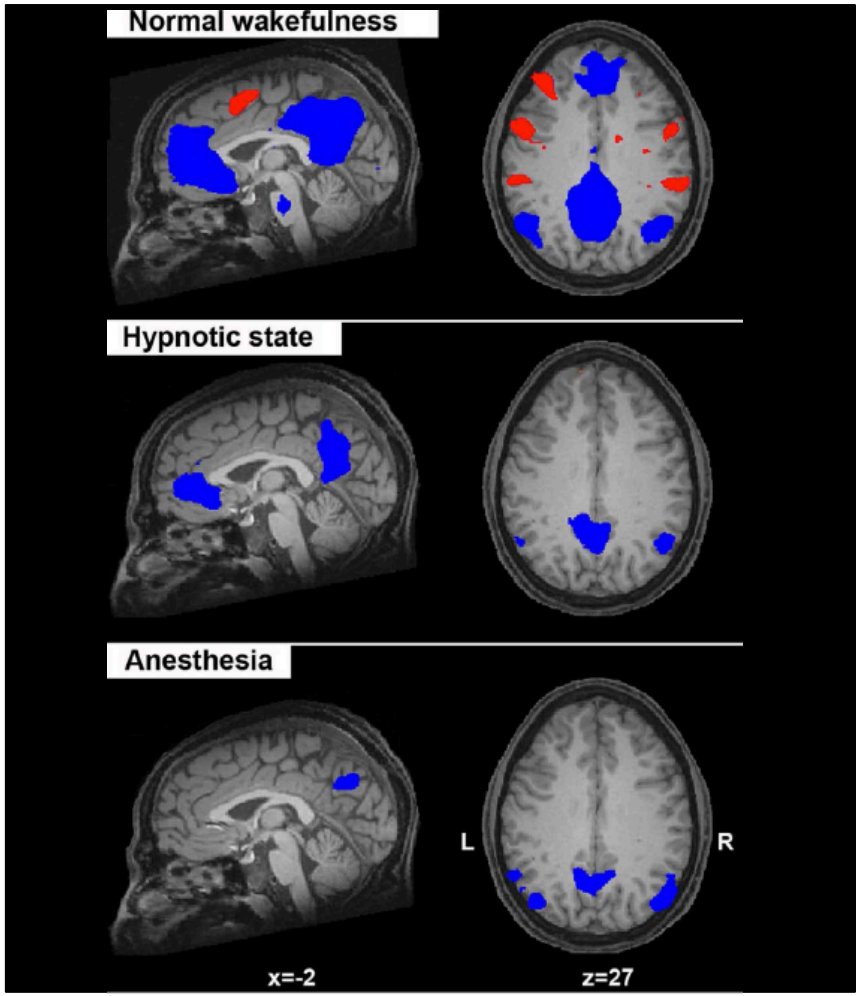


Heine, Di Perri, Soddu, Laureys, Demertzi, In: *Clinical Neurophysiology in Disorders of Consciousness,* Springer-Verlag 2015

Demertzi & Laureys, In: *I know what you are thinking: brain imaging and mental privacy*, Oxford University Press 2012

fMRI resting state and cognition

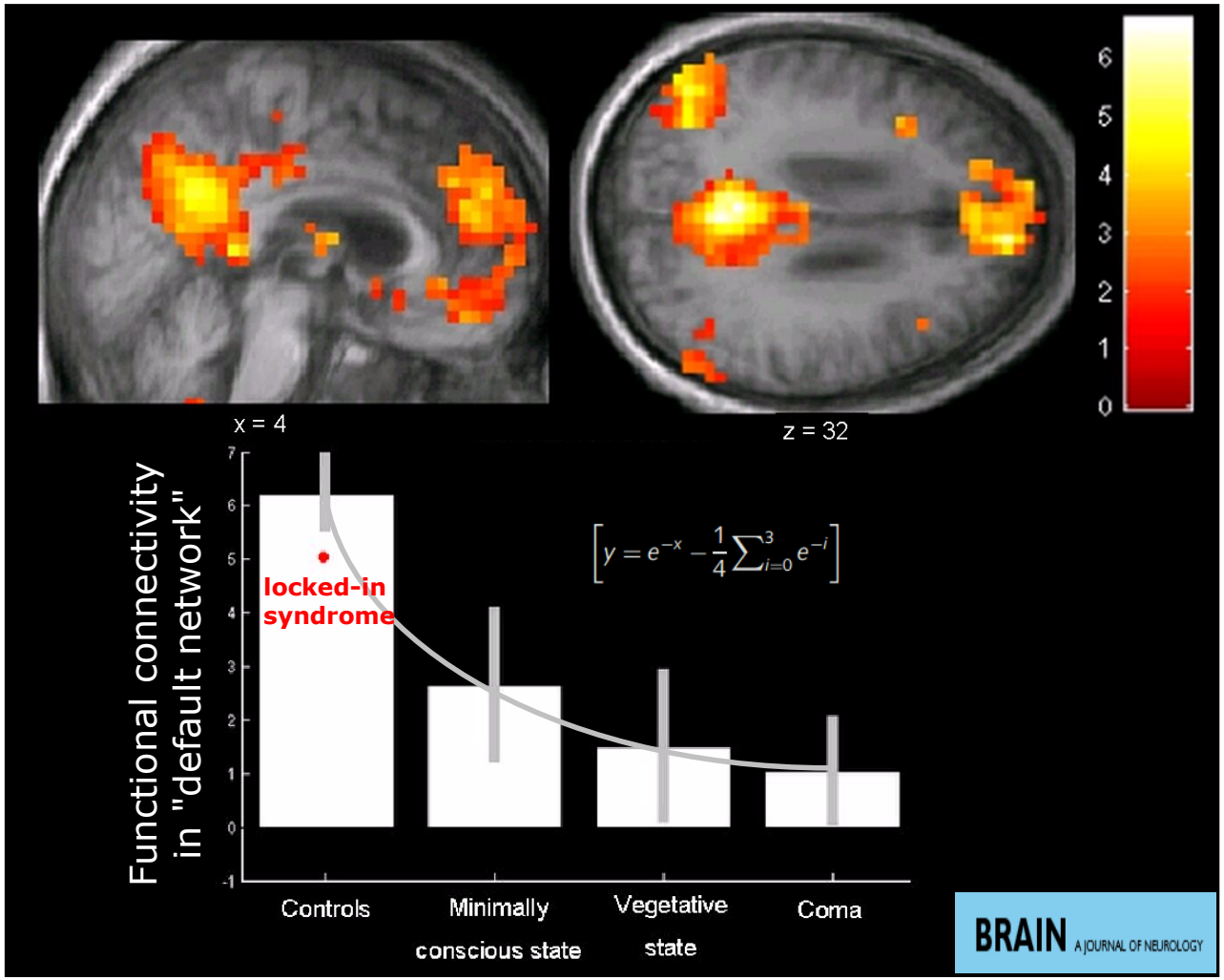




Vanhaudenhuyse & Demertzi et al, J Cogn Neurosci 2011

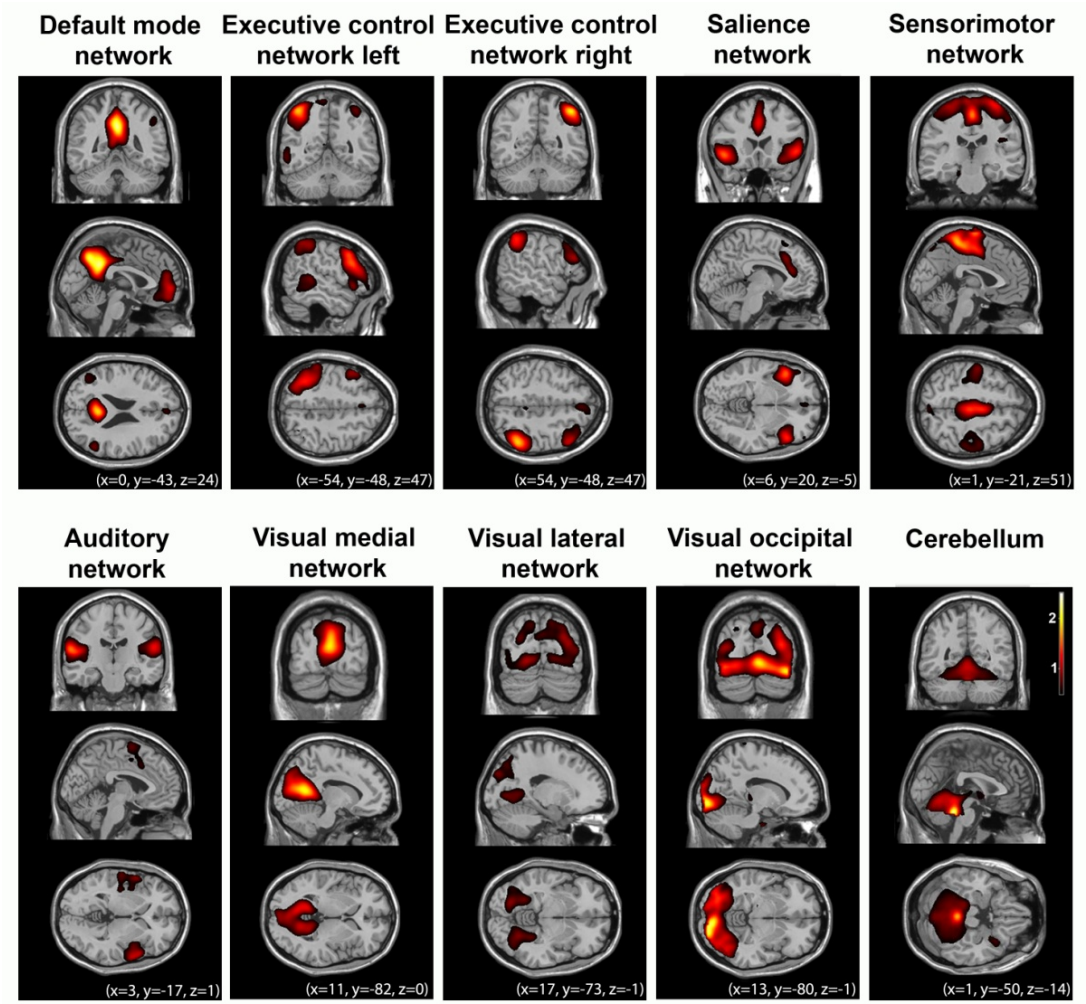
Demertzi & Whitfield-Gabrieli, in: *Neurology of Consciousness in press*
Demertzi, Soddu, Laureys, Curr Opin Neurobiol 2013
Demertzi et al, Front Hum Neurosci 2013
Demertzi et al, Prog Brain Res 2011

Disrupted DMN in patients

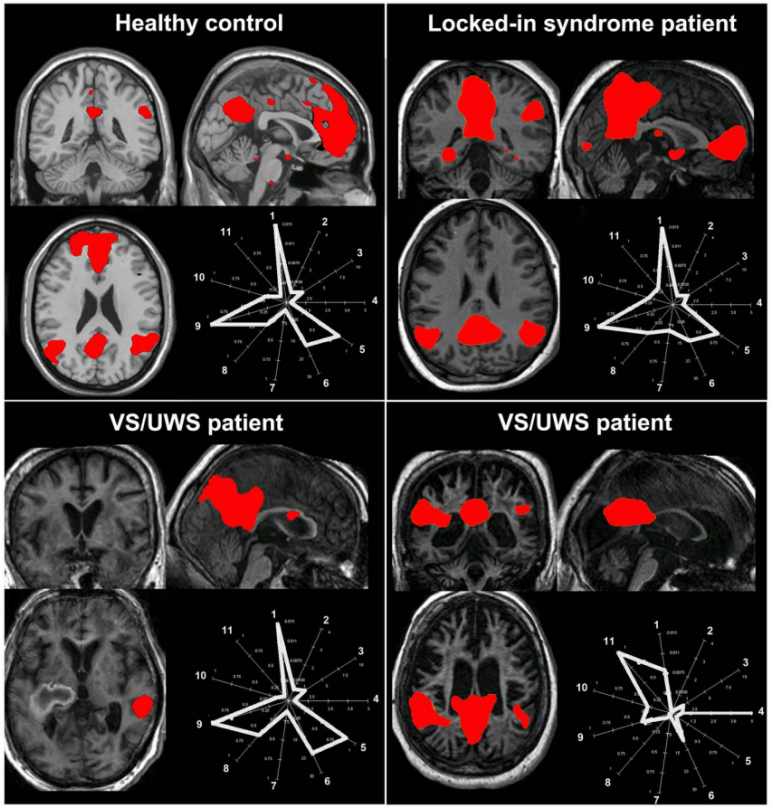


Vanhaudenhuyse & Noirhomme et al, Brain 2010

Multiple RSNs in DOC: issues

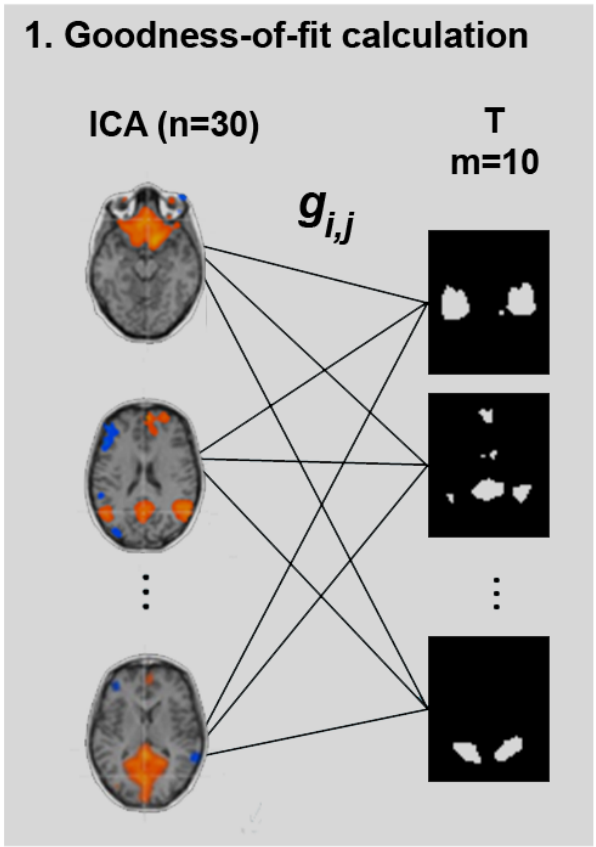


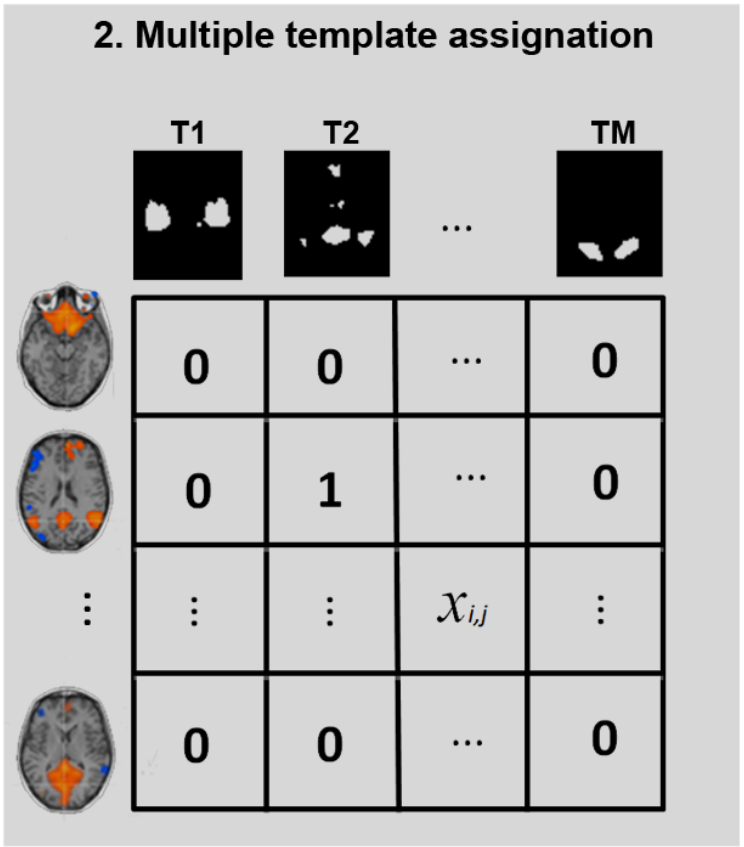
A challenge….

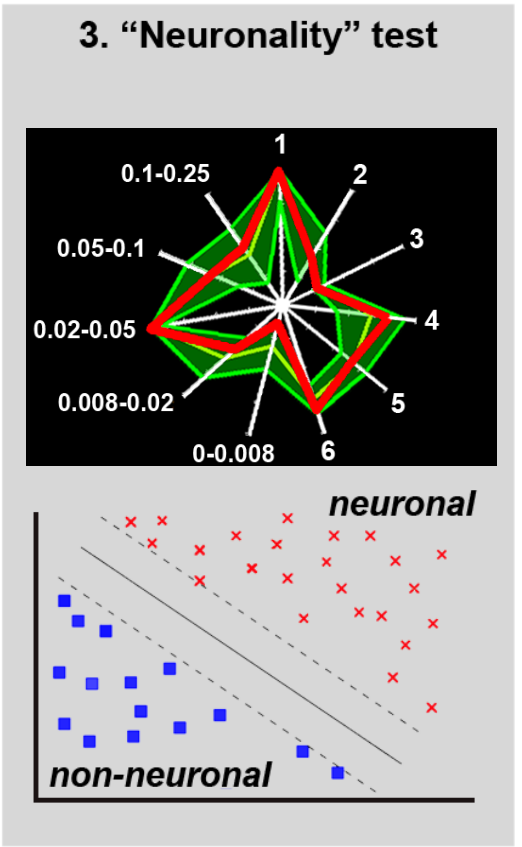


Heine et al, Frontiers in Psychology 2012
Smith et al, PNAS 2009
Beckmann et al, Phil. Trans. R. Soc. B 2005

Multiple RSNs in DOC: an approach







Demertzi & Gómez et al, Cortex 2014

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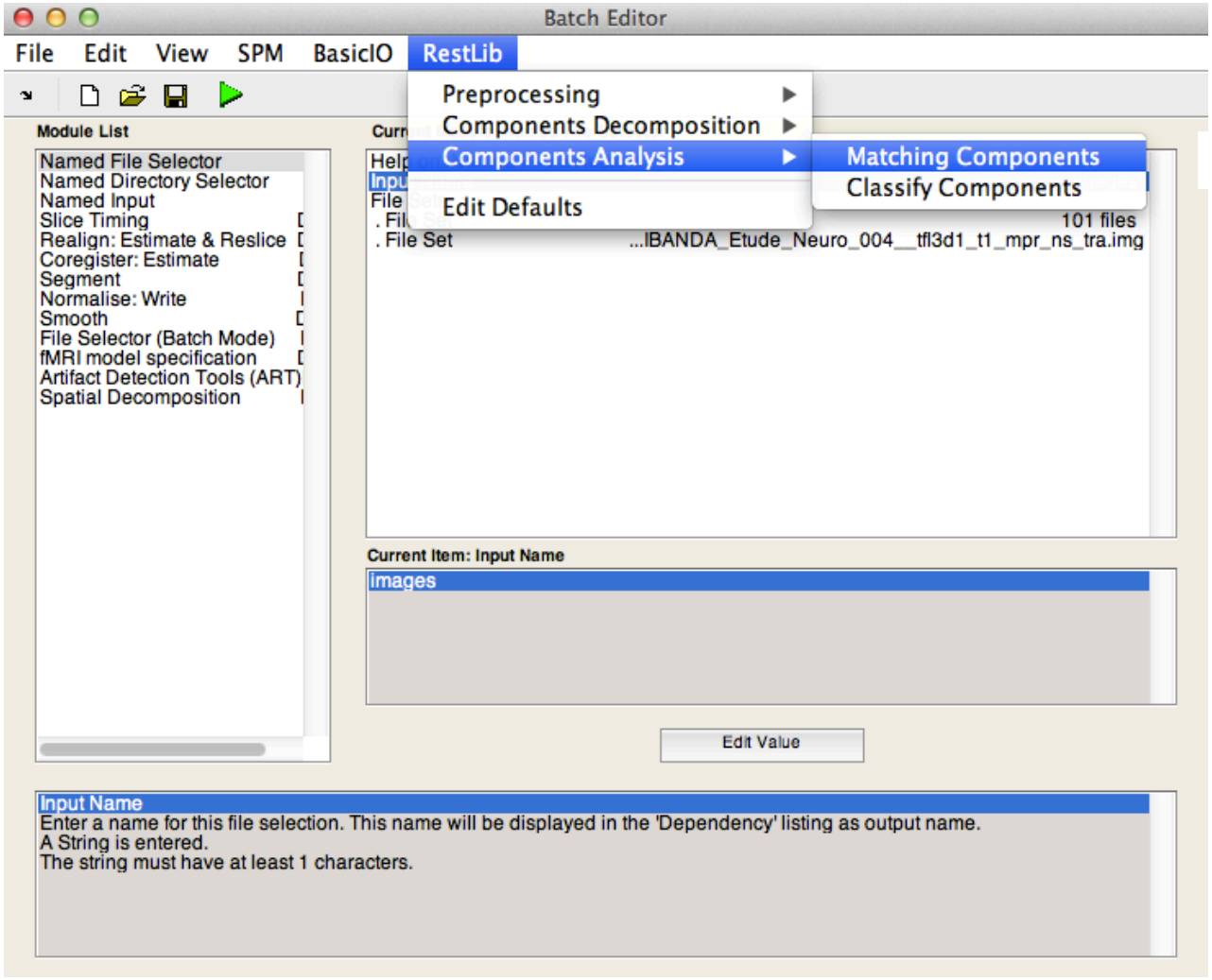

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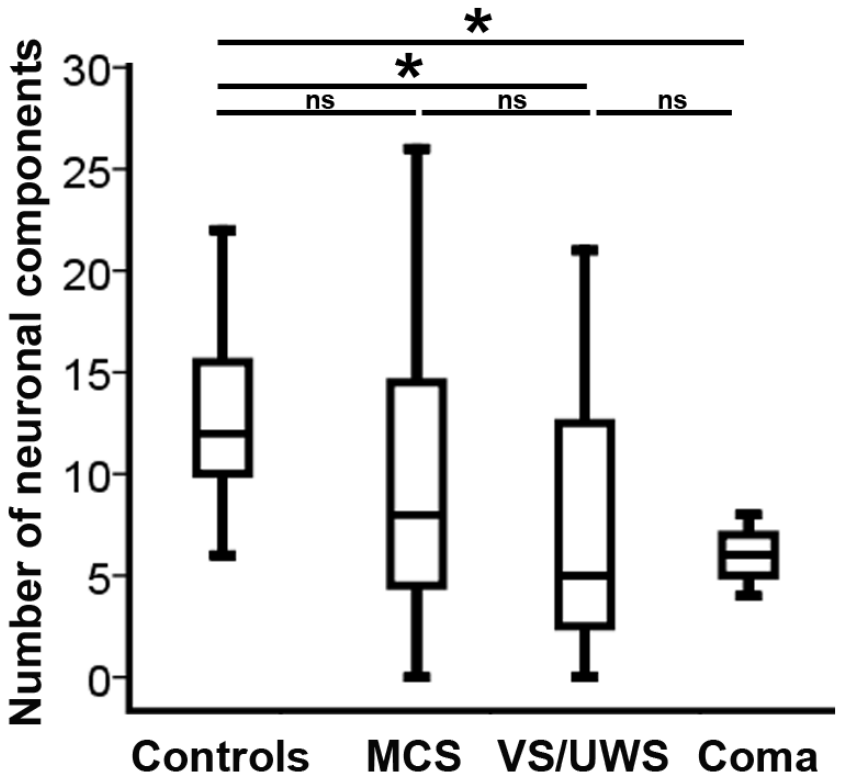
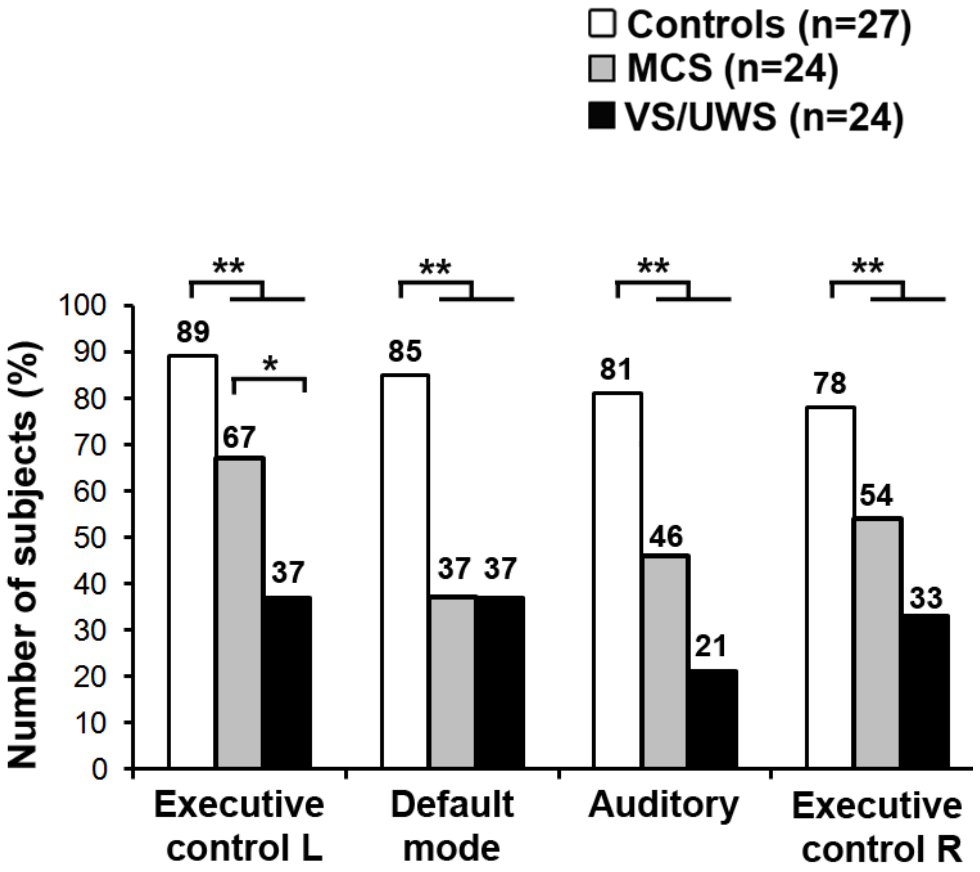
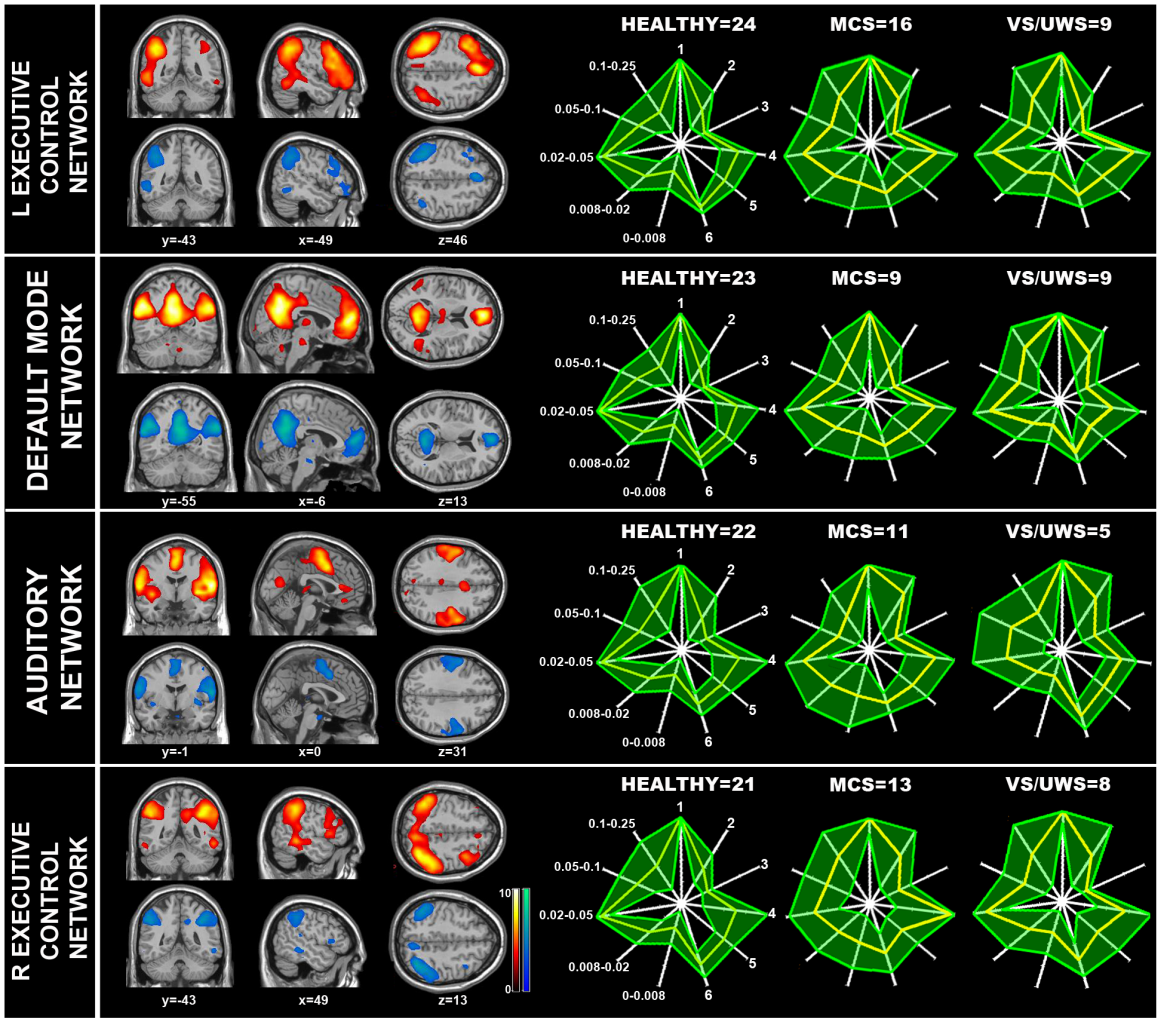
Fewer "neuronal" networks in DOC





Demertzi & Gómez et al, Cortex 2014

Voxel-wise group comparisons



Controls N=27
MCS N=24
VS/UWS N=24

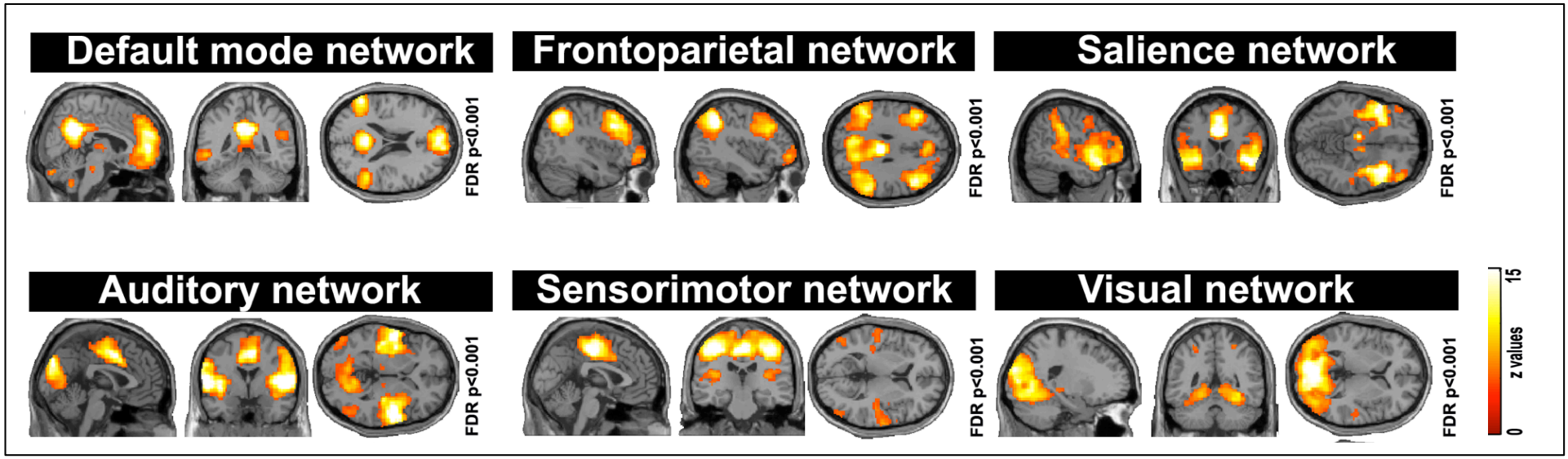
Demertzi & Gómez et al, Cortex 2014

Classification feature: "neuronality"

Performance measures	Accuracy	TPR healthy	TPR patients	Selected RSNs
	Healthy vs. all patients			
Occurrence	85.3	.82	.87	Auditory, DMN
Occurrence & GOF	82.6	.70	.89	Auditory, DMN, Visual lateral
GOF	80	.78	.81	Auditory, DMN, ECNL, Visual lateral

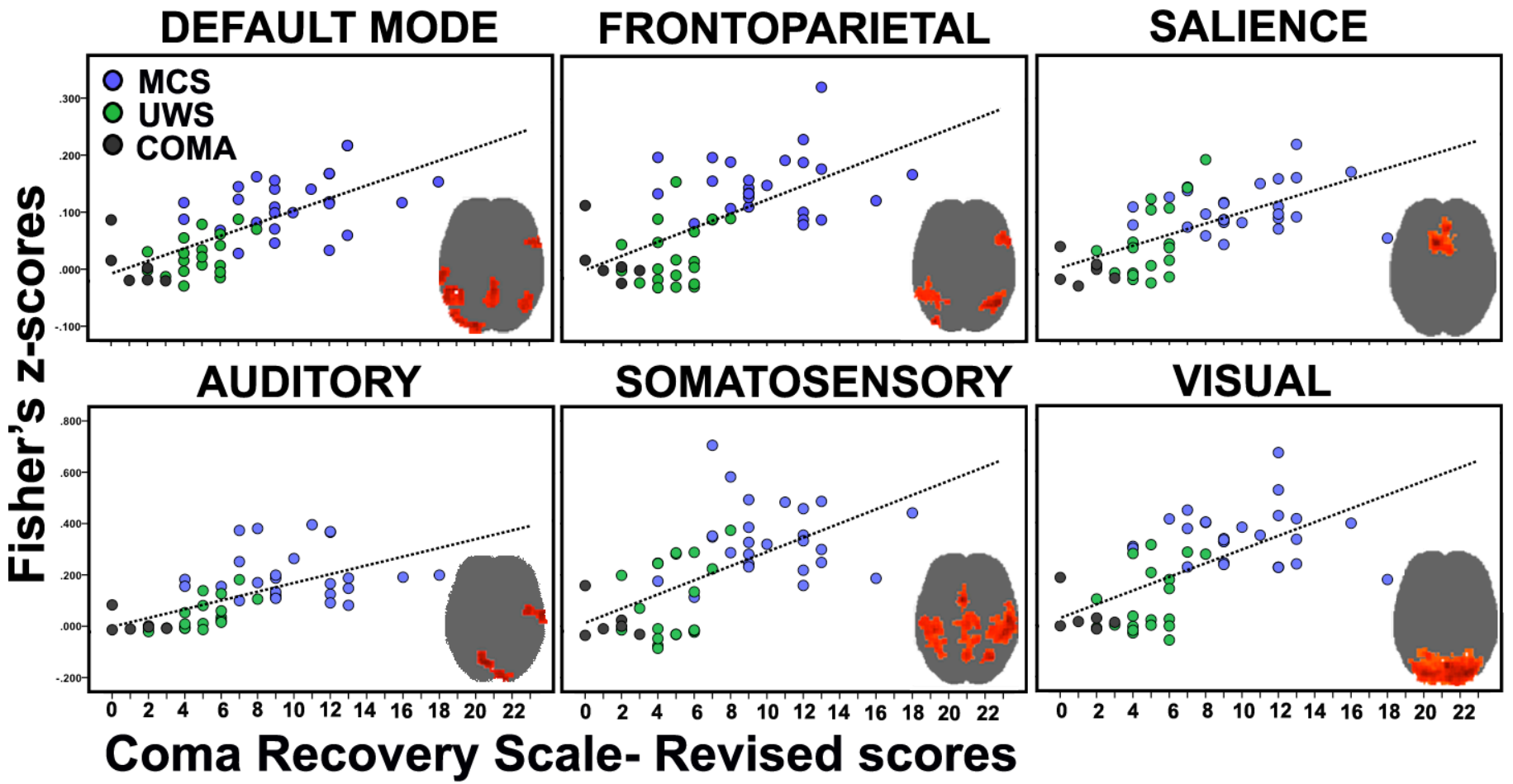
Demertzi & Gómez et al, Cortex 2014

Network connectivity in healthy



Demertzi & Antonopoulos et al, Brain in press

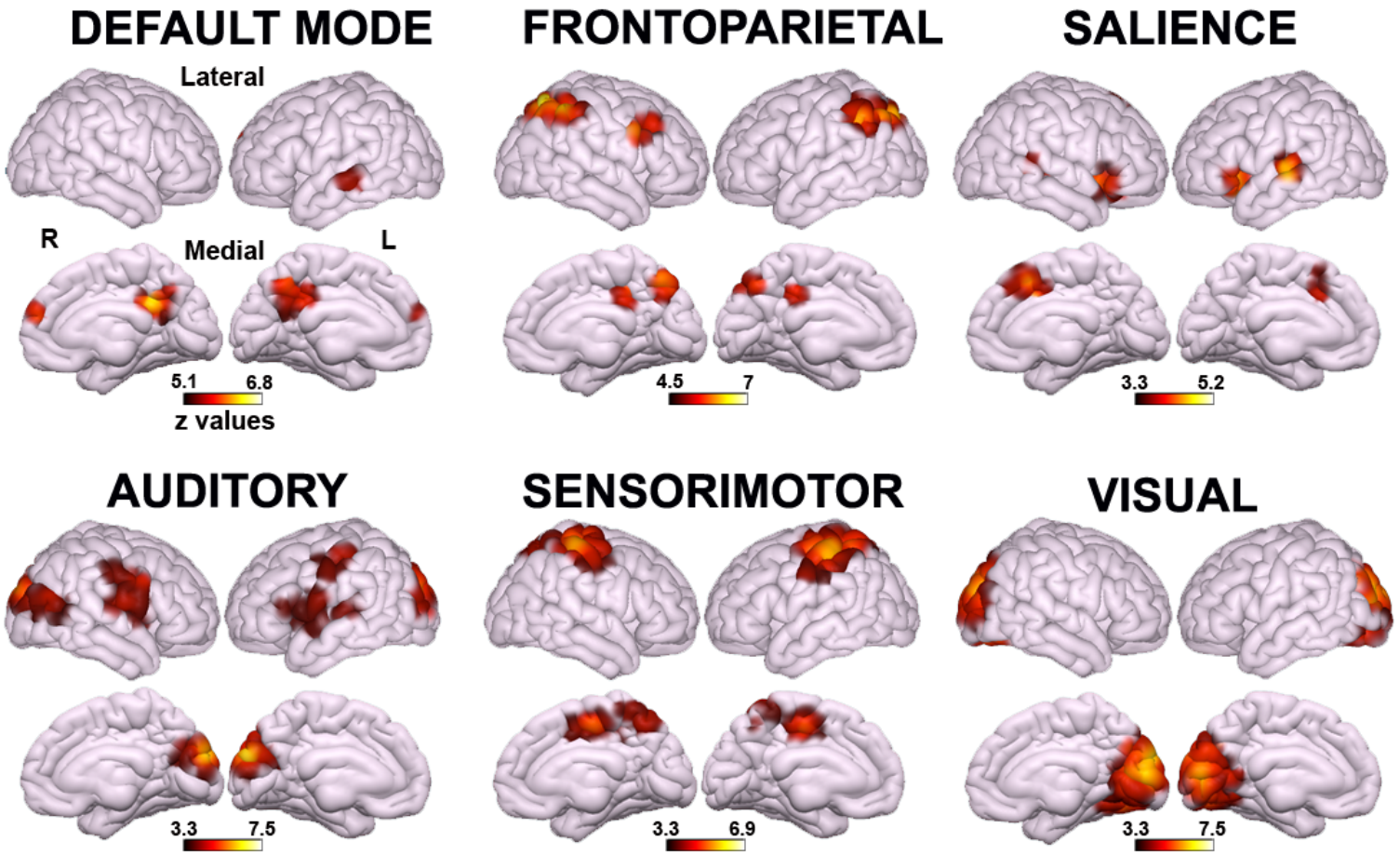
Intrinsic connectivity reflects level of C



Demertzi & Antonopoulos et al, Brain in press

Finding the discriminative features

MCS > VS/UWS

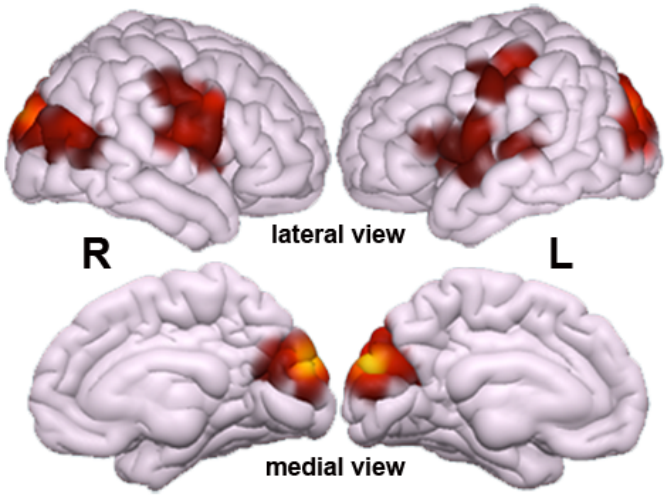


FWE p<0.05 (cluster-level)

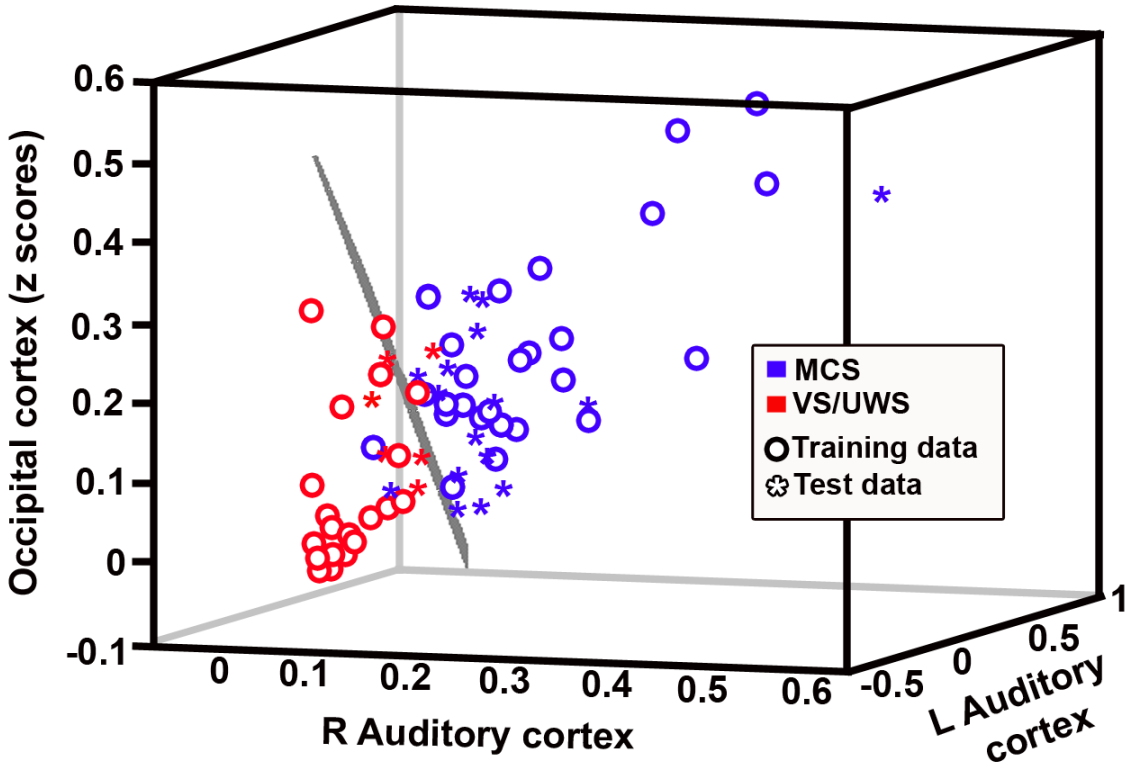
Demertzi & Antonopoulos et al, Brain in press

Training dataset: patients (Lg)

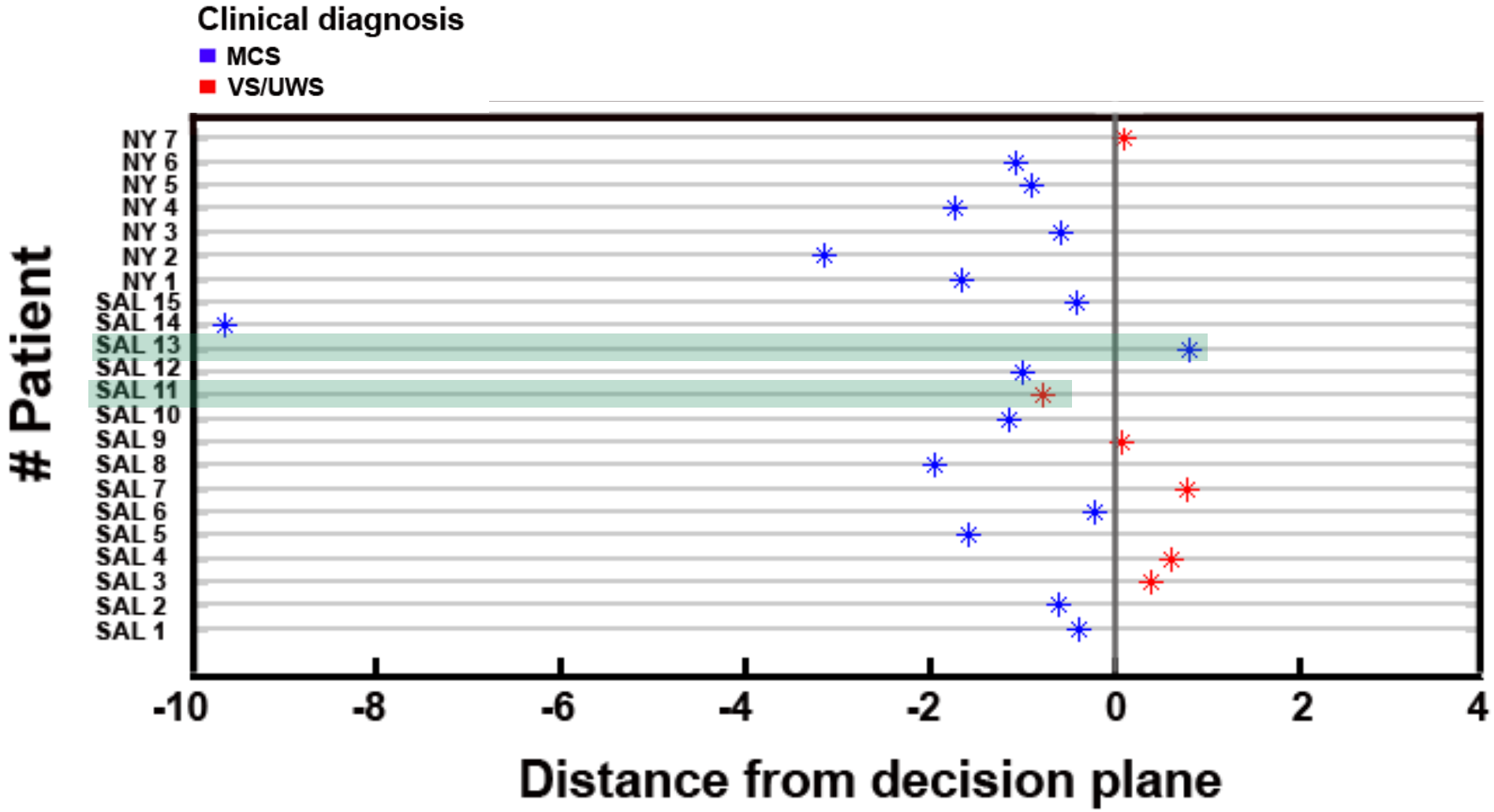
- 26 MCS, 19 VS/UWS
- 14 trauma, 28 non-trauma, 3 mixed
- 34 patients assessed >1m post-insult



R auditory w = -1.7890
L auditory w = -0.4002
Occipital w = -0.7362

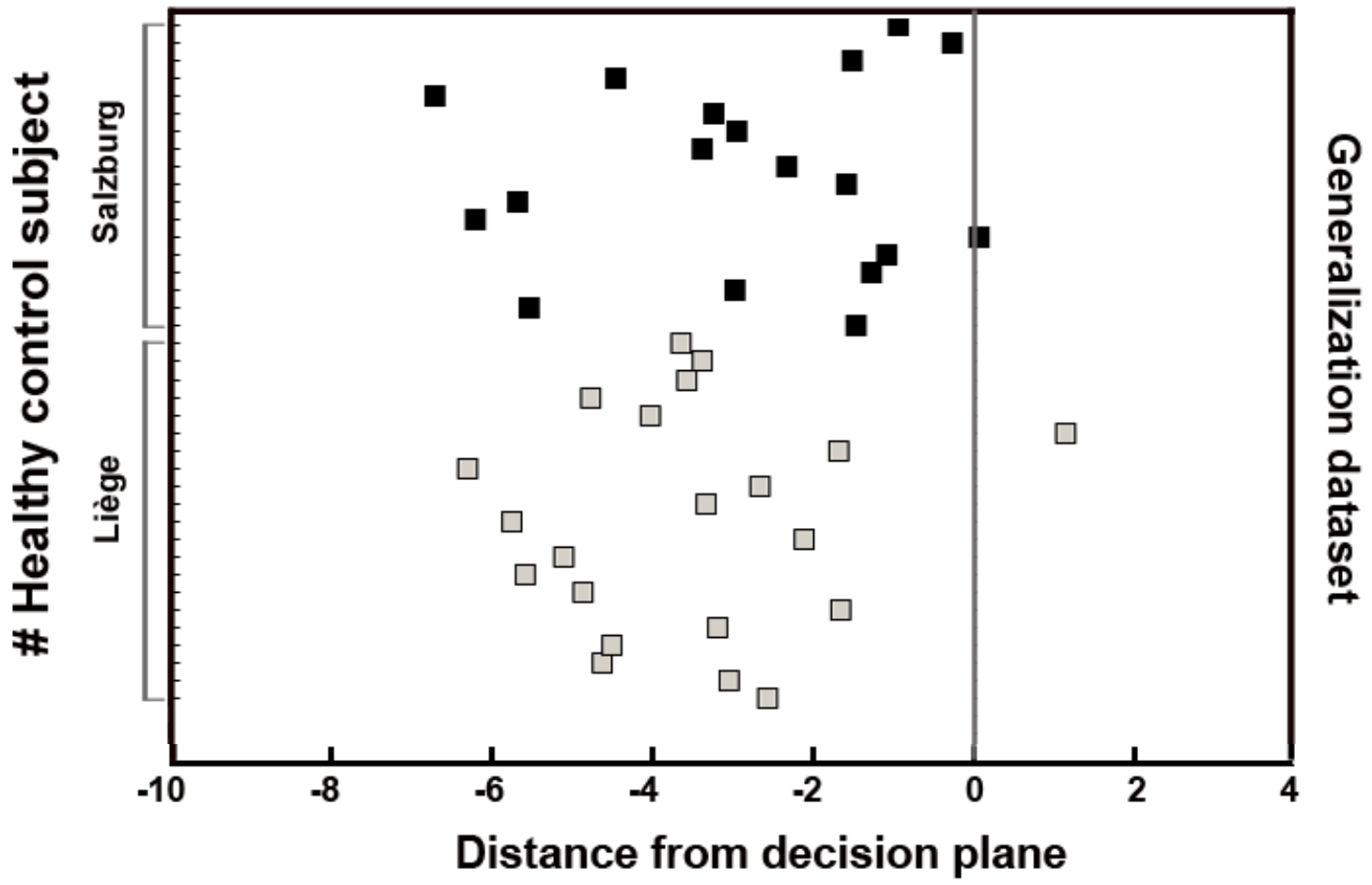


Validation dataset: patients (NY, Sal)



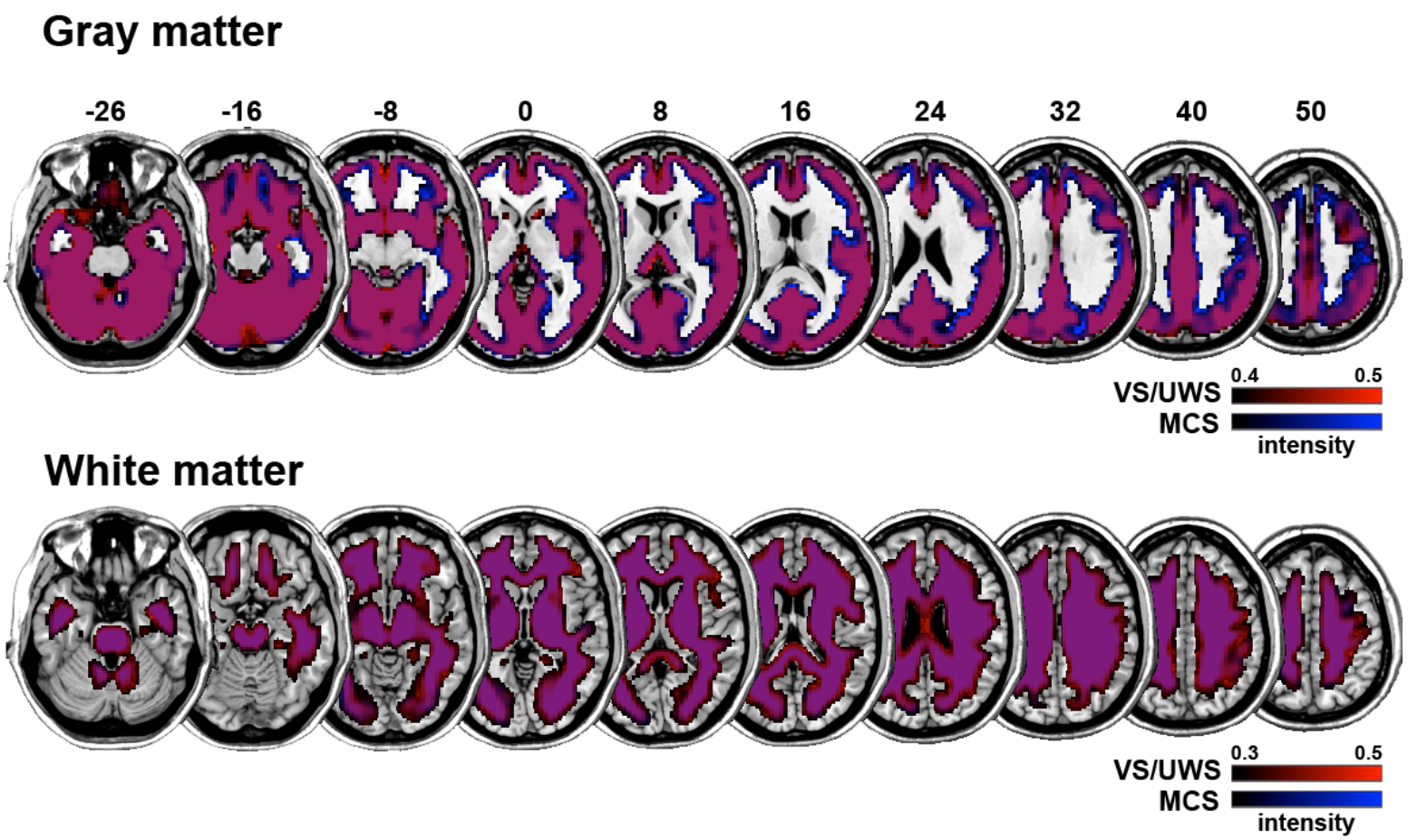
Demertzi & Antonopoulos et al, Brain in press

Generalization dataset: healthy



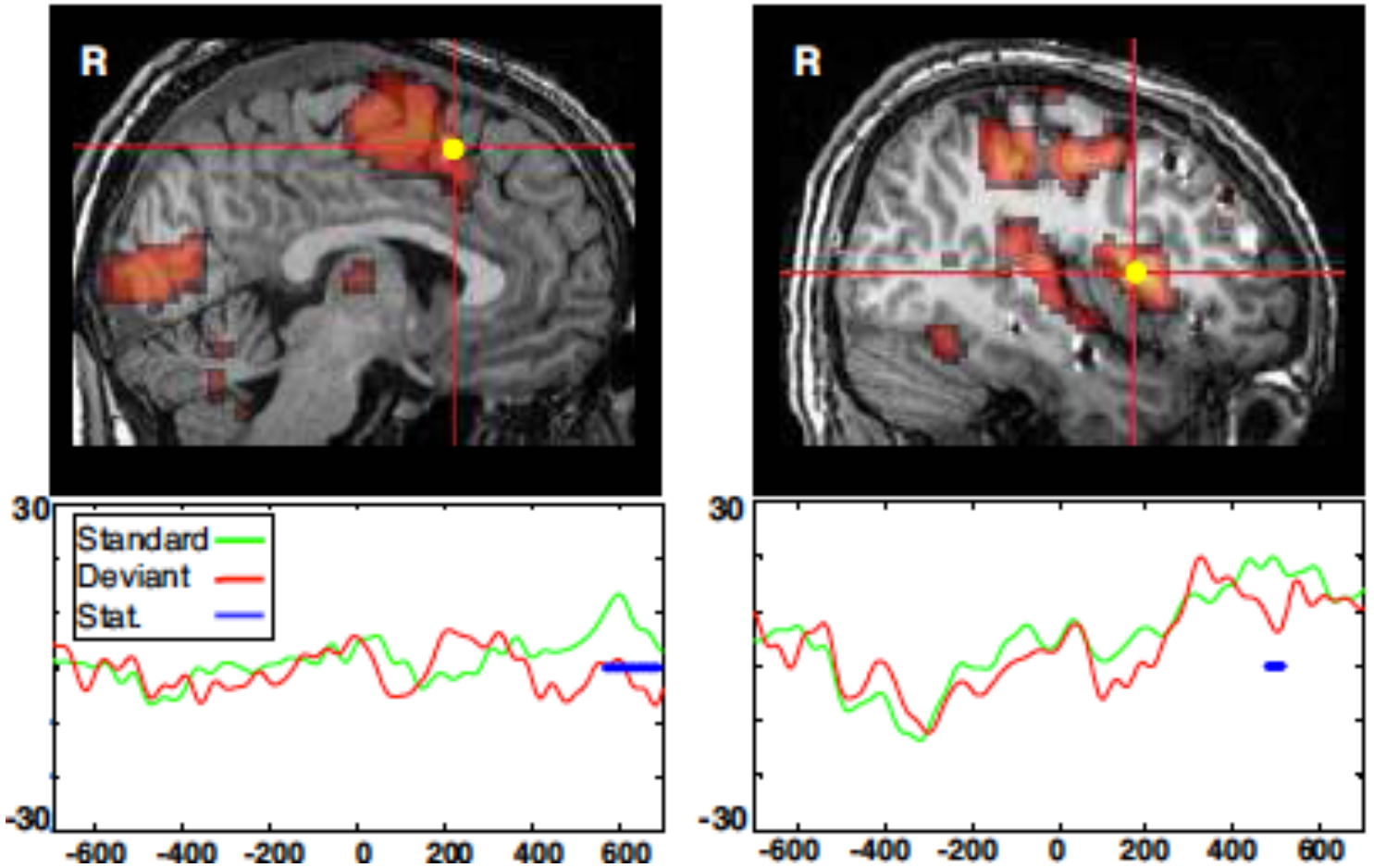
Demertzi & Antonopoulos et al, Brain in press

Echoes from structural connectivity?



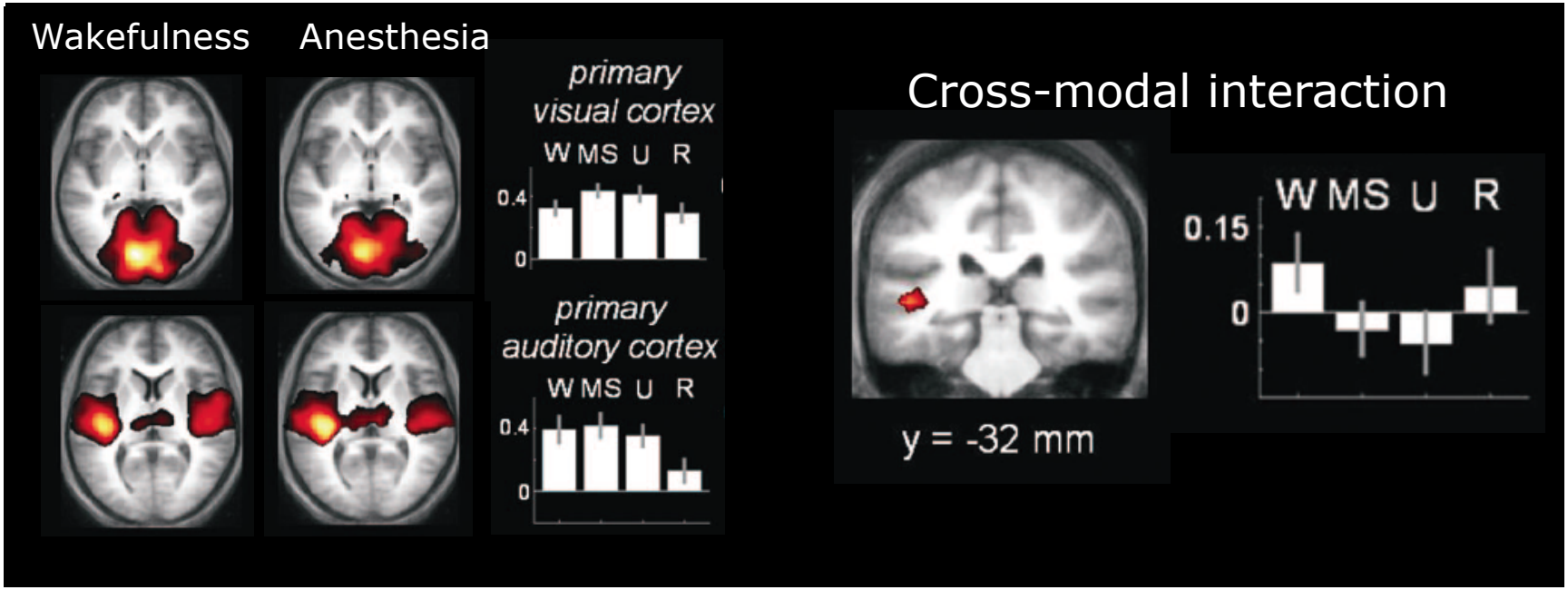
Demertzi & Antonopoulos et al, Brain in press

Cross-modal interaction during conscious processing



Bekinschtein et al, PNAS 2009

Cross-modal interaction demolishes under propofol anesthesia



Translational research

rsfMRI Biomarkers

↓

Diagnostic & prognostic use

↓

Medico-ethical issues in DOC

Niko Schiff & Henning Voss,
Weill Cornel Medical College

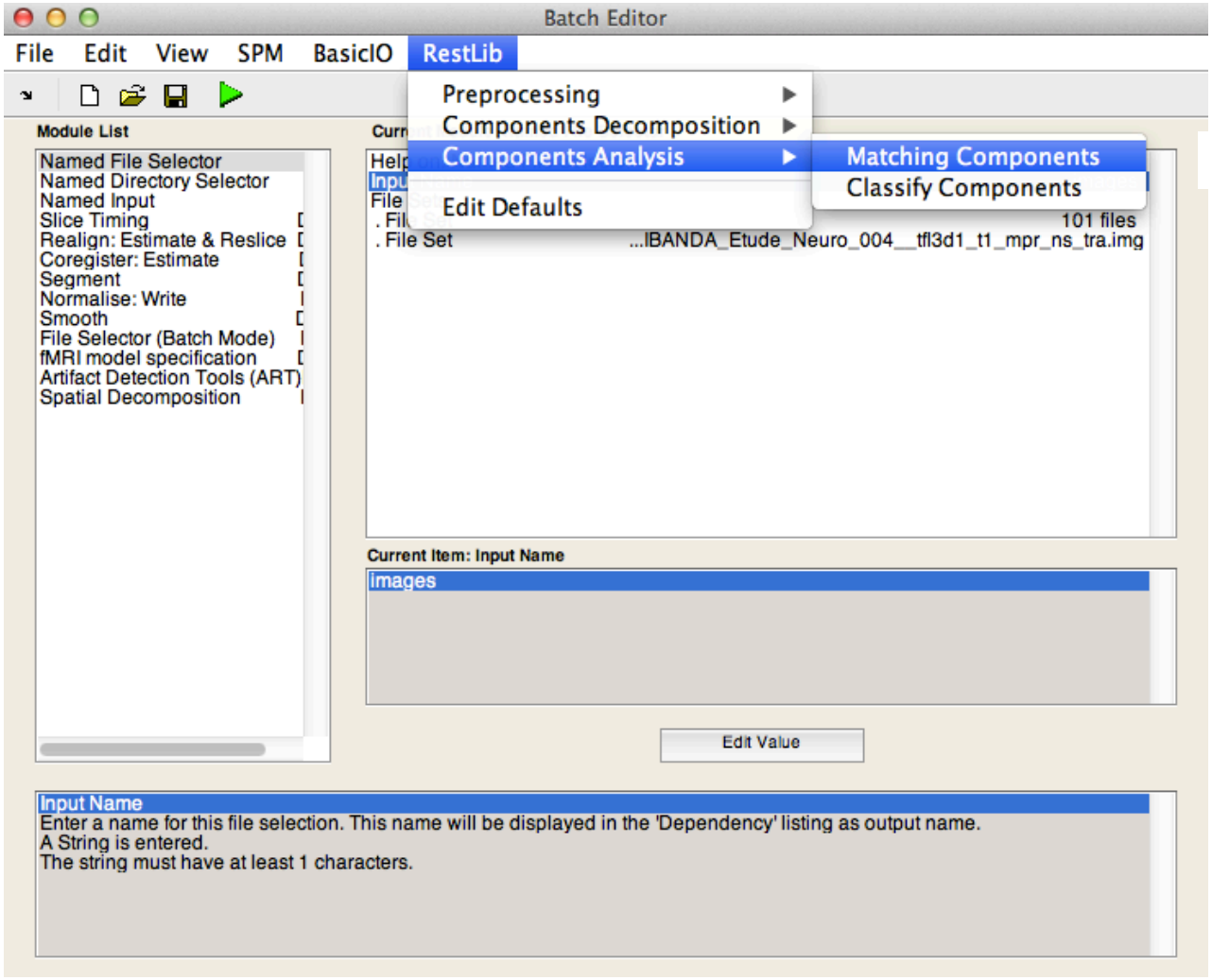
Julia Sophia Crone & the
Salzburg team

The deparments of
Neurology and Radiology in
Liege and Paris

**...but mostly patients
and their families!**

athina.demertzi@icm-institute.org

The Coma RestLib



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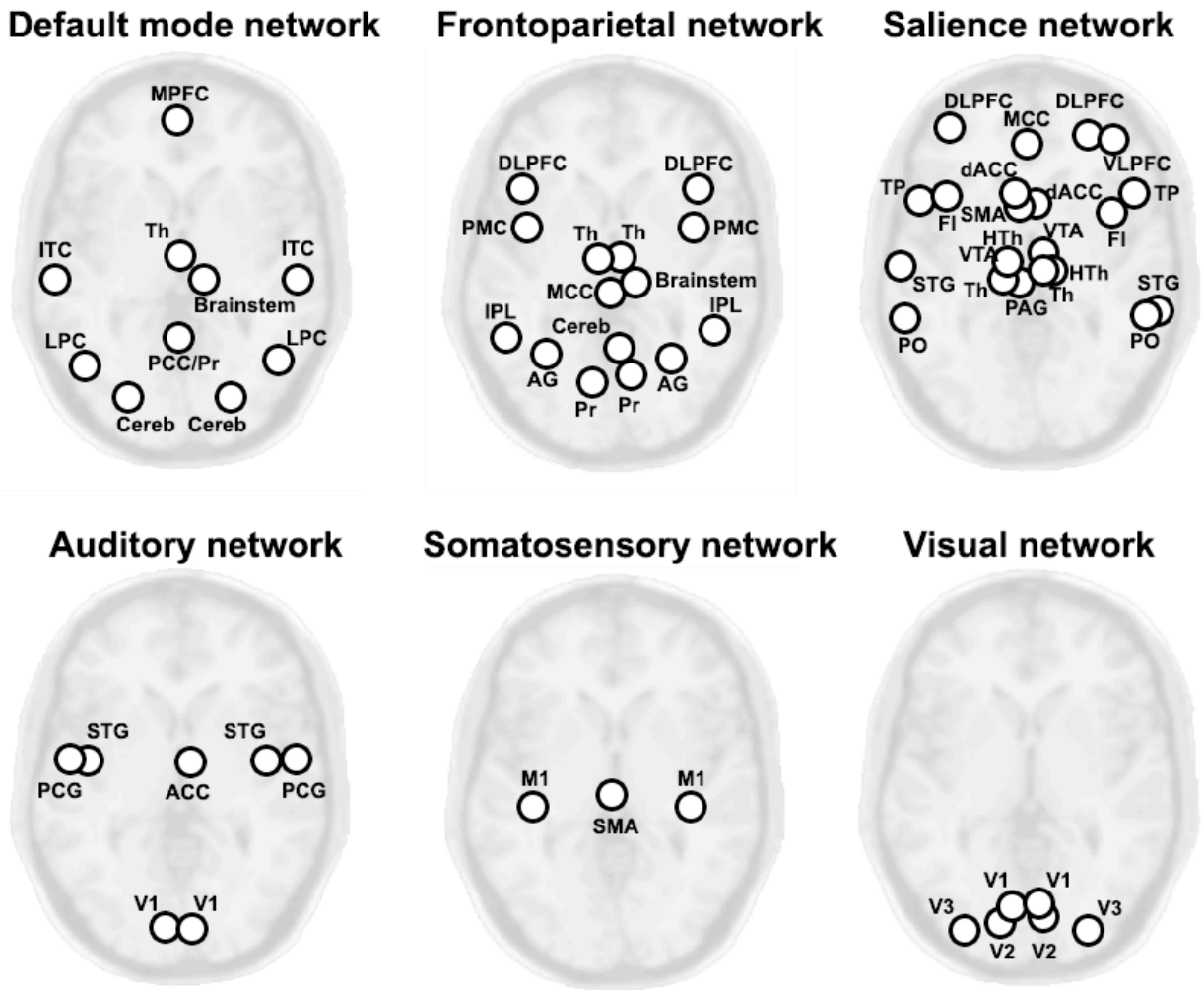
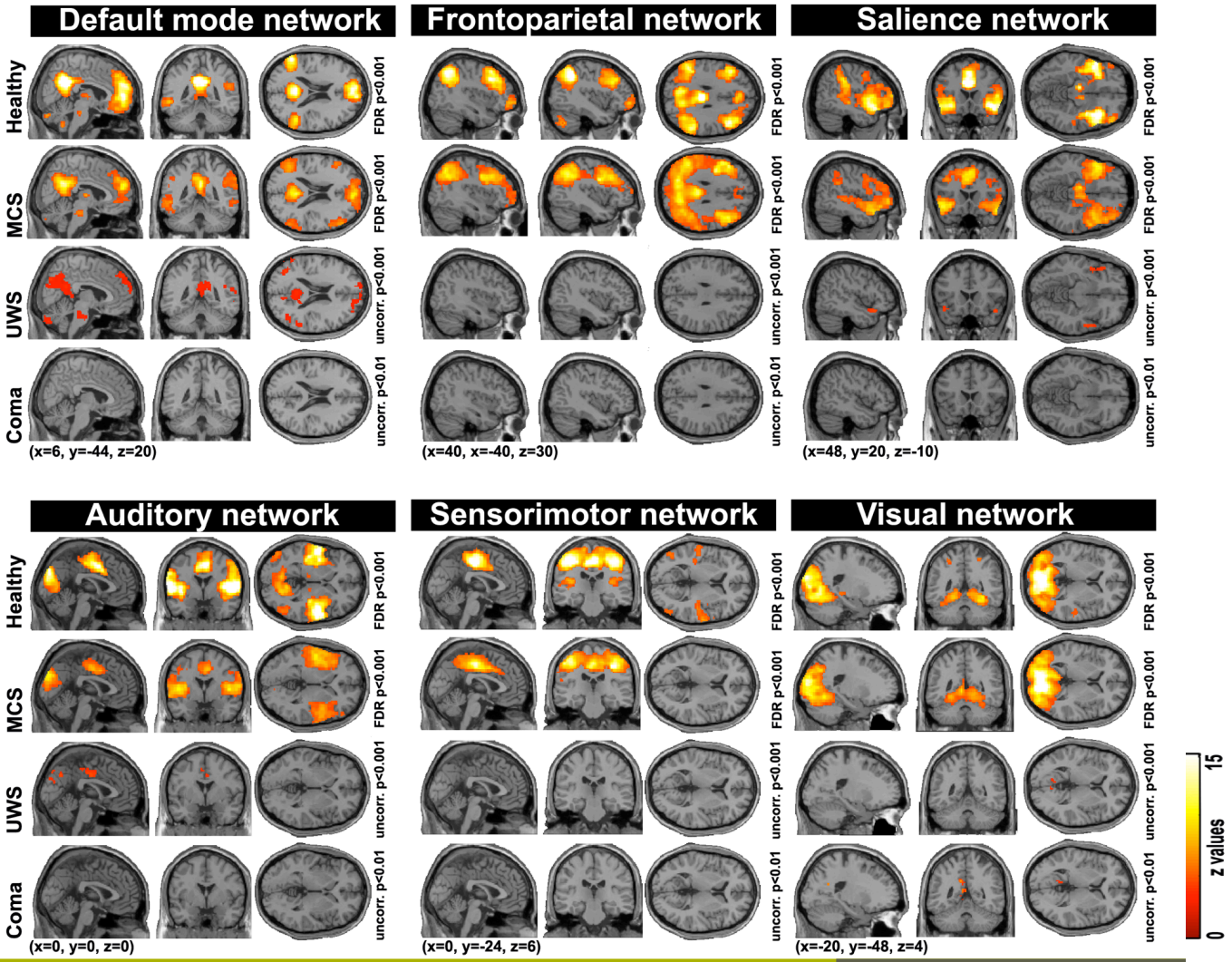
Seed positions



Demertzi et al, submitted

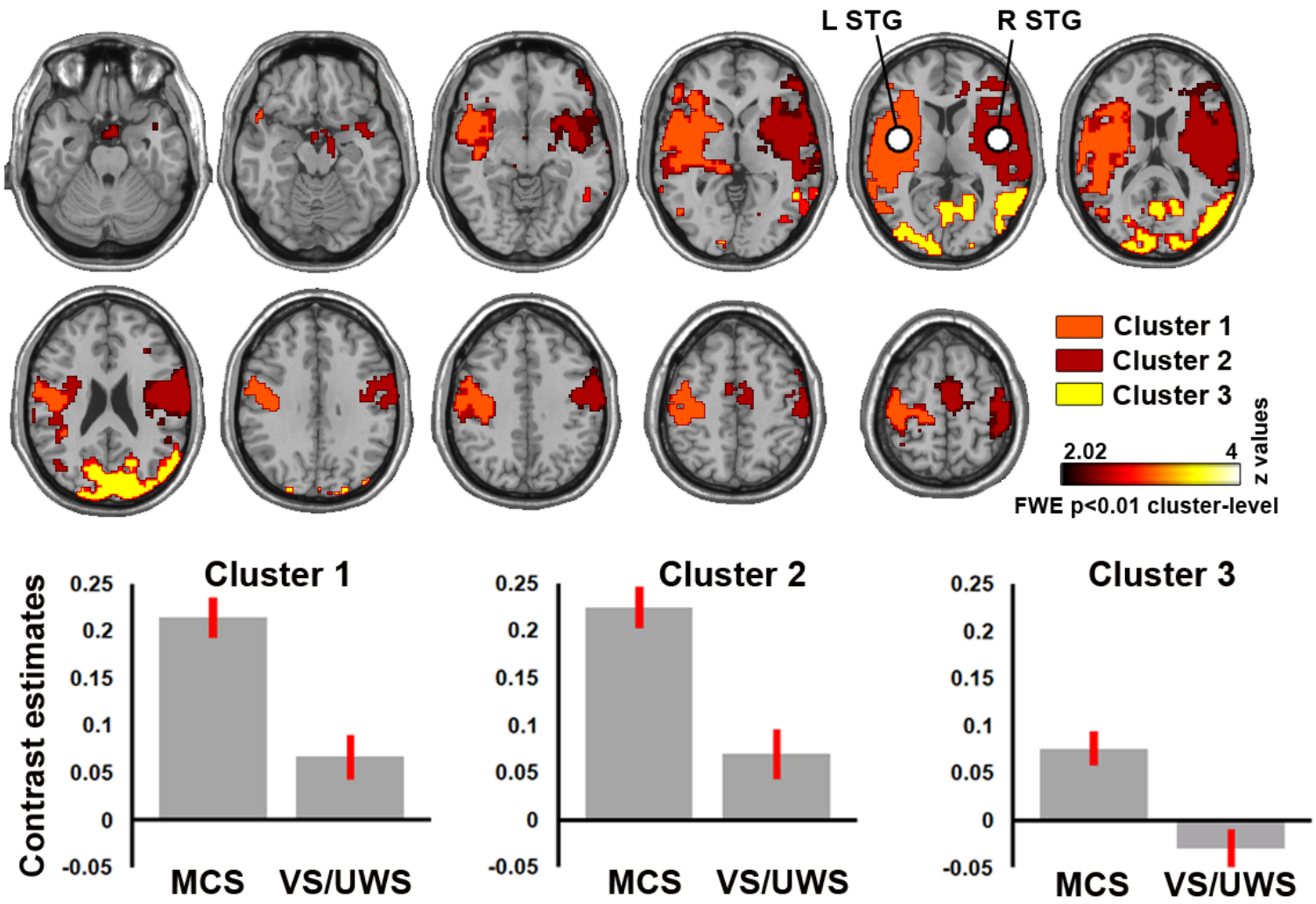
The studied RSNs



Controls N=21
MCS N=26
VS/UWS N=19
Coma=6

Demertzi et al, submitted

Disentangling the crossmodal interaction



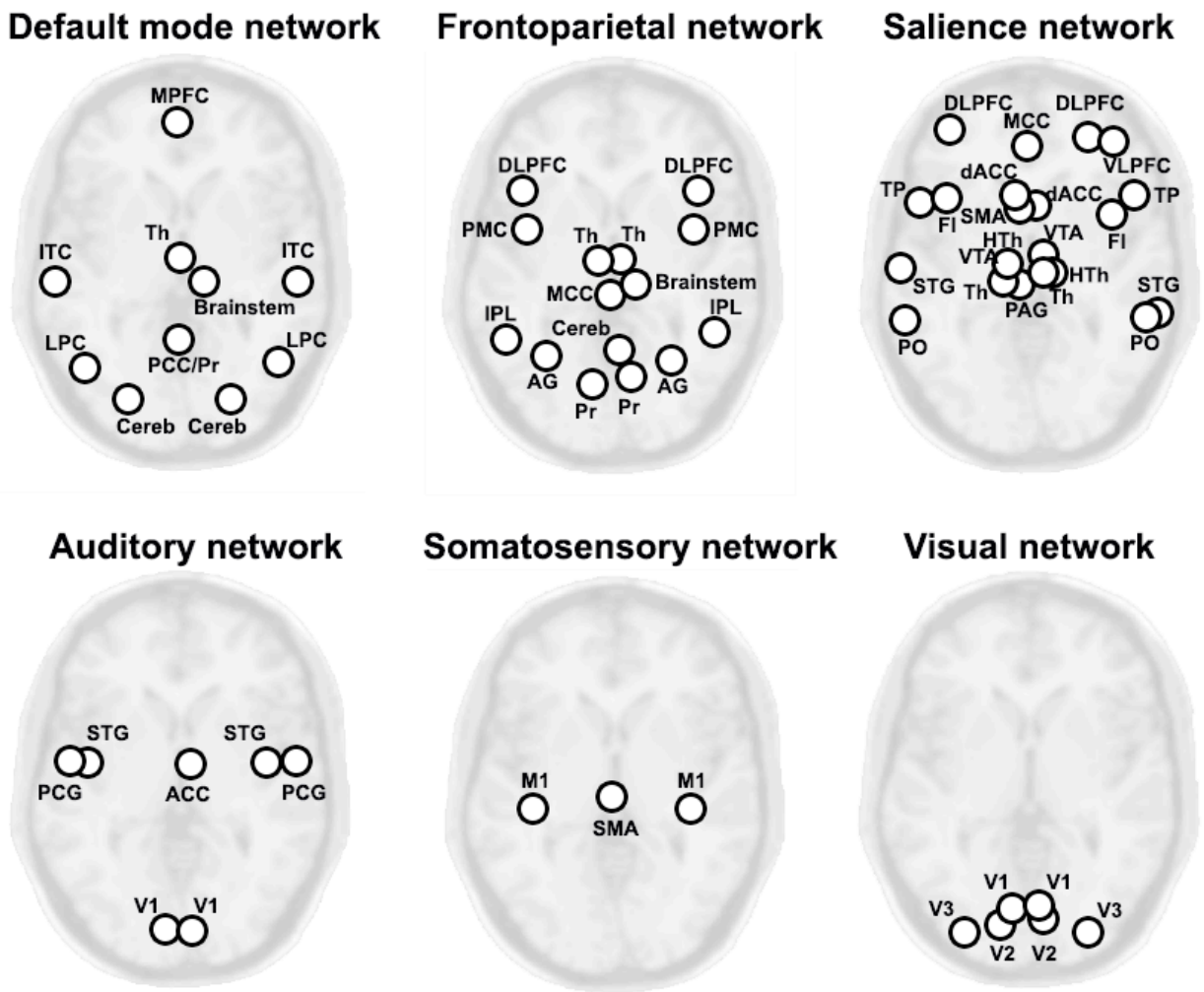
Demertzi et al, submitted

Feature ranking

	Feature selection criterion (t-test)			Single-feature classification		
Network	t value	Rank	p value	True positives (MCS)	True negatives (VS/UWS)	Performance accuracy
Auditory	8.32	1	<.001	25	18	43/45
Visual	7.79	2	<.001	23	15	38/45
Default mode	6.95	3	<.001	23	15	38/45
Frontoparietal	6.82	4	<.001	23	15	38/45
Salience	6.21	5	<.001	24	15	39/45
Sensorimotor	5.87	6	<.001	24	13	37/45

Demertzi et al, submitted

The studied networks



Analysis pipeline