Comparison of the Resting State as Imaged by FDG-PET and fMRI in Patients with Mild Cognitive Impairment (MCI)

Afra M. Wohlschläger[1,2,3], Valentin Riedl[1], Alexander Drzezga[2], Isabelle Stangier[2], Christian Sorg[4]

MOLECULAR IMAGING IN DEMENTIA

[1]Department of Neurology, [2]Department of Nuclear Medicine, [3]Department of Neuroradiology, [4]Department of Psychiatry, Technische Universität Munich, Germany

1. Introduction: A diagnostic tool for detecting early stages of Alzheimer's Disease (AD) is lacking until today. FDG-PET (Fluorodeoxyglucose-Positron Emission Tomography) shows hypometabolic areas in the brains of predemented MCI-patients, who have a high likelihood of converting to AD. The reduced activity could be attributed to disrupted connectivity of the resting-, or default-mode network of the brain. A set of Resting State Networks can be investigated using functional magnetic resonance imaging (fMRI) and independent component analysis (ICA). Out of those the default mode network is selectively affected by the disease. The present study aims at comparing the resting state characterized by the two methodologies. Both methods were performed within the same patients.

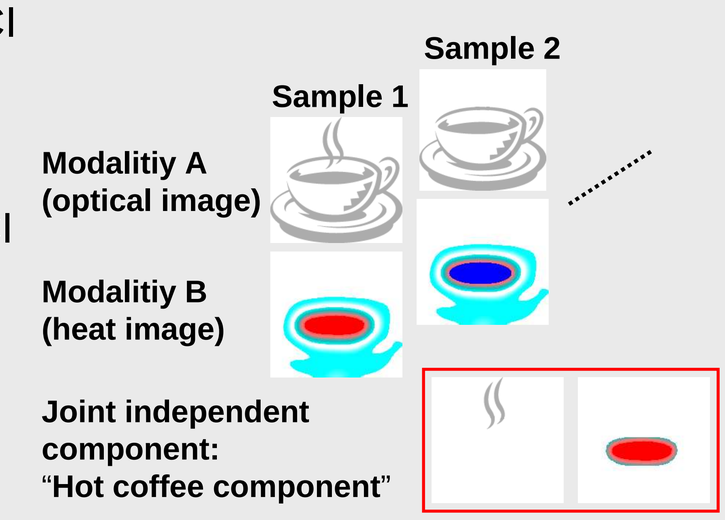
2. Methods:

MCI-Patients: 21 patients received FDG-PET and 4 min of rest fMRI-scanning ("Close your eyes, but do not fall asleep!")
Age-matched healthy controls (CTR): rest fMRI-scanning: 16 subjects, FDG-PET: 27 subject (different collective)

rest fMRI ⇒ group-ICA: default-mode network → group-comparison: CTR > MCI

FDG-PET ⇒ ICA: default-mode network → group-comparison: CTR > MCI

⇒ **fusion-ICA**



ICA and in case of rest fMRI group-ICA was performed using GIFT [1], fusion-ICA was performed using FIT [1], group-comparison was performed using two-sample t-test within the framework of SPM5 [2].

Fig.1: Fusion-ICA detects areas which vary similarly across samples in two different imaging modalities. Changes do not necessarily have to occur in corresponding localisations.

3. Results: ICA on the FDG-PET patient data results in 3 independent components, one containing areas with major veins, the second containing the cerebellar region, and a third one containing most of the cortex including areas of the default mode network (Fig. 2).

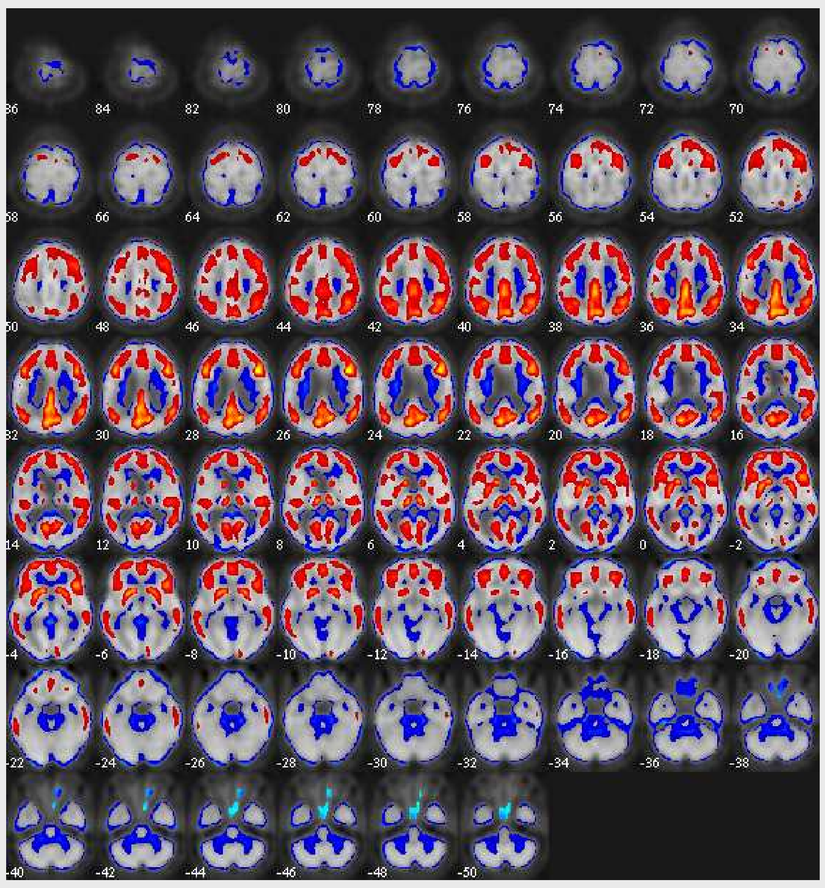


Fig.2: ICA on patient FDG-PET data set. Independent component involving regions of the default mode network.

Fusion ICA extracts a joint component of the default mode network and FDG-PET data. In both imaging modalities, this component covers structures characteristically showing reduced metabolism in MCI as determined from FDG-PET, namely the posterior cingulate, the medial parietal, the lateral parietal, and medial frontal cortex.

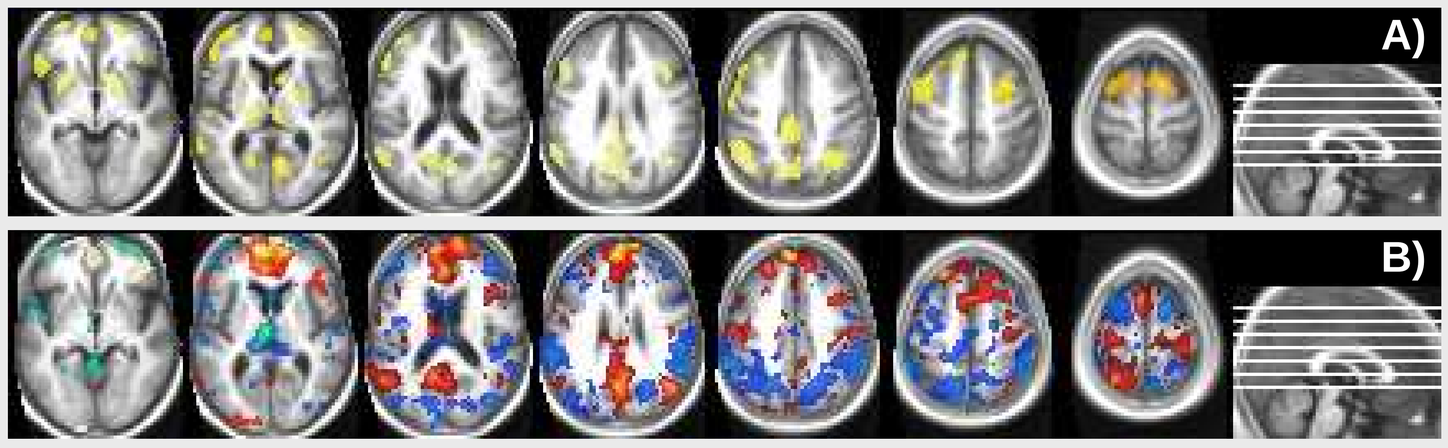


Fig.3: Joint independent component of default mode network as derived from rest-fMRI and FDG-PET superimposed onto average anatomical image. A) fMRI part (>20% of max. value). Red - yellow, areas correlating positively, blue - green, areas correlating negatively. B) corresponding FDG-PET part (>60% of max. value, grey-scale). Slices are positioned as indicated.

6. Conclusion: We have shown that resting state data derived from either FDG-PET or fMRI bear common features across modalities. Our data hint at a systematic connection of hypometabolism and altered resting state connectivity in the posterior cingulate cortex in MCI. Sensitivity of the analysis was increased by the rare opportunity of employing data in both modalities acquired within the same subjects.

[1] http://icatb.sourceforge.net [2] http://www.fil.ion.ucl.ac.uk/spm