fMRI Responses of Alzheimer’s Disease and Mild Cognitive Impairment Patients during Target Detection

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INTRODUCTION

- Oddball target detection paradigms elicit systematic widespread fMRI brain activations²³⁴ and only one study demonstrates how these activations are affected in Mild Cognitive Impairment (MCI) (4) and none for Alzheimer’s Disease (AD).
- This study investigates the differences in activations among healthy subjects, MCI and AD patients in an auditory oddball event related fMRI experiment.
- We also aim to investigate studies [5] that report areas of increased activations in pre-MCI and MCI stages and their subsequent affection in AD.

METHODS

- Subjects: 10 healthy - 20 MCI – 11 AD
- Paradigm: Auditory Standard Stimuli (1000Hz, 80%) and Target Stimuli (1500Hz, 20%). Subjects are instructed to respond with a unilateral button press to Target Stimuli.
- Imaging: BOLD images (EPI, TR 2.4 s, 64x64 matrix, FOV 230 mm) - Structural image (T1, 1.25 x 1.25 x 1.2 mm voxel size) using a 1.5 Tesla Philips System.
- Preprocessing (SPM8): Realignment, slice timing, motion correction, co-registration, normalization (MN152, 3 mm), smoothing (Gaussian Kernel of FWHM 9 mm).
- Subject level Statistical Analysis (SPM8): Standard stimulus (single regressor) Target Stimuli (two regressors: correct and wrong responses). Motion correction parameters and time derivatives of hemodynamic response function were included in general linear model. Contrasts used: Main effect of correct Target Stimuli relative to Standard Stimuli.
- Group level Statistical Analysis (SPM8): Contrast images used as inputs for an ANOVA analysis of the 3 groups.

RESULTS

Common Areas affected in MCI and AD patients relative to Controls
- Frontal Lobe
  - Bilateral Ventro-Lateral Prefrontal Cortex (VLPCF) within the inferior frontal gyrus
  - Left Dorsal-Lateral Prefrontal Cortex (DLPFC) within middle and superior medial frontal gyri
- Right Superior Frontal Gyrus
- Right Supplementary Motor Area (SMA)
- Anterior Cingulate Cortex (ACC)
- Temporal Lobe: Right Superior Temporal gyrus
- Parietal Lobe: Right Supra-marginal gyrus
- Occipital Lobe: Right Cuneus, Fusiform and Lingual gyri

Discussion and Conclusion

- Our results are the first to document AD patients fMRI activations in an auditory target detection task.
- Our results supports the only study [4] that documents the areas implicated in MCI.
- AD show similar but stronger patterns as MCI patients of decreased activations relative to healthy elderly subjects.
- Prominent differences of AD seem to implicate the caudate nuclei, posterior cingulate gyrus and left superior temporal gyrus.
- Our results support the studies [5] reporting that the same areas affected in AD demonstrate increased activations in pre-MCI stages.

REFERENCES


Figure 1. Groups comparisons for areas which show increased activity to Target Stimuli (with a correct response) relative to Standard Stimuli. Differences between Control and MCI subjects (Left), Control and AD subjects (Middle) and MCI and AD subjects (Right). p value uncorrected at 0.01. Voxels Ext Threshold at 10.

Areas exclusively affected in AD patients relative to MCI and Controls
- Temporal Lobe: Left Superior and Middle Temporal Gyri
- Parietal Lobe: Left Supra-marginal gyrus
- Posterior Cingulate Cortex
- Occipital Lobe: Right Precuneus
- Basal Ganglia: Bilateral Caudate Nuclei