Correlations in fMRI of the Amygdalae: Motion or Emotion?

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Introduction

In a fMRI study of emotional discrimination in schizophrenics and controls we observed stimulus-correlated head motion in response to the presentation of images of faces in both groups, as has been reported elsewhere (Hajnal et al. 1994). Here, healthy subjects were imaged without stimulus but reproducing the head motion observed in the initial study either by moving the patient couch or voluntarily, by subjects themselves in response to a visual cue.

Materials and methods

Four subjects were studied with GR-EPI with parameters that have typically been applied in amygdala fMRI to date (64x64 matrix, 4 mm slices with 6 mm interslice interval, TE=34ms, 17 slices in TR=2s, NR=100). Subjects fixated on a crosshair whilst the patient couch was shifted with a range of displacements below 1 mm, then, in a second run, were instructed to generate small z-axis movements of the head alone, cued by the change in colour of a small circle at the centre of the crosshair.

Analysis

Data were analysed using SPM99, including image normalisation to a standard template, spatial smoothing with a 9 mm Gaussian kernel, and were evaluated both with and without motion correction. Regressors in the model were periods of displacements.

Results

High correlation values were seen in the amygdalae region in all subjects, and in the anterior cingulate gyrus in some cases. Figure 1 shows quasi-activation for a single subject under self-generated movement of an amount identified by the SPM99 motion correction algorithm to be less than 0.8 mm (shown in the same figure).

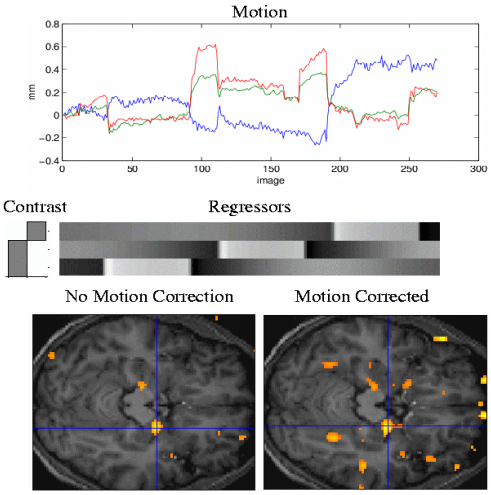

Figure 1. Identified translational motion (top), regressors for intended patient motion and contrast (middle) selected for correlation images evaluated both with and without motion correction (bottom, p>0.0001), overlayed on T1-weighted images of the subject.

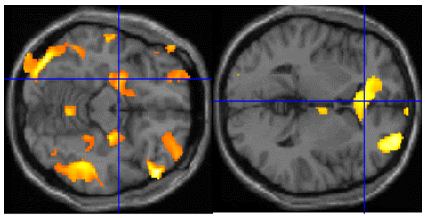

Figure 2. Correlation values from data generated by periodic shifts of the patient table in both the amygdala (left) and anterior cingulate gyrus (right) (indicated by the position of crosshairs), overlayed on an SPM T_1 template.

Discussion and conclusion

Even contrasts employing the difference in correlation values in a number of blocks (as are commonly used in "cognitive subtraction" experiments) involving apparently similar motion (periods 1,2, and 3 in Figure 1, differing by approximately 0.3 mm) have been shown to give rise to highly significant and focal correlations resulting from the motion alone. Given that the subject motion examined here would generally be regarded as innocuous in fMRI and would be treated with standard motion correction algorithms, such correlations are likely to explain some or all of the observed correlations in limbic region fMRI experiments to date. There is clearly a need for techniques to separate such artefacts from genuine activation.

Reference Hajnal JV, et al (1994). Magn Reson Med. Mar;31(3):283-91.

Acknowledgement. S.R. gratefully acknowledges receipt of a Human Frontiers Science Program short-term fellowship award