Diminished hemodynamic responses during processing of mood congruent emotional adjectives in depressed patients

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Introduction

A variety of fMRI studies examined the impact of the emotional content of words on neuronal activation patterns using active word processing [1-3] or passive reading [4]. The processing of emotional words is associated with an increased activation in frontal (inferior and medial), temporal and limbic brain regions, corresponding to an increased activation in brain regions responsible for processing of verbal stimuli. Psychiatric patients with affective disorders, e.g. major depression showed less activation to happy words in frontotemporal, orbitofrontal and limbic regions and elevated activation to sad stimuli in the lateral orbitofrontal cortex, the anterior temporal cortex during explicit processing of the emotional word content [6] and the left inferior parietal lobule [5]. No performance differences were found between patients and controls in these studies suggesting that the effect exists on a neuronal but not on a behavioral level.

The primary objective of the presented fMRI study was to determine whether passively reading pleasant and unpleasant adjectives leads to comparable mood congruent activation differences in depressed patients relative to healthy controls.

Methods

12 healthy volunteers (10 female, 2 male, mean age 36, SD 6 years) and 8 psychiatric patients suffering from a depressive episode (mean BDI score 18, SD 15, 5 female, 3 male, mean age 43, SD 10 years) participated in this study. All were right-handed and native speakers of German and gave written informed consent. The subjects were instructed to read the presented words silently. 3 x 34 highly arousing pleasant and unpleasant and low arousing neutral adjectives were randomly visually presented for 1 second in a event-related fMRI design in a 1.5 T Siemens Magnetom Vision Scanner. As baseline condition the non-word ‚XXXXXX' was presented in the interstimulus intervals. 28 parallel axial EPI slices (4 mm thickness, 1 mm gap, TR 3 s, FOV 220 mm, 64^2 matrix) were acquired. Statistical analysis was performed with SPM2. For healthy controls the contrasts word > baseline and emotional > neutral were calculated and entered in a second level analysis (one sample t-test) in order to verify the influence of the emotional connotation of the adjectives.

For each individuum the following contrasts were assessed: unpleasant > pleasant, pleasant > unpleasant, pleasant> neutral and unpleasant > neutral. To evaluate a mood congruent bias the individual t-contrast images were entered in a second level analysis (two sample t-test) to compare the BOLD response of patients (Pat) to those of healthy controls (HC). Differences were considered statistically significant for a value of $p < 0.001$ (uncorrected for multiple comparison) and a cluster size of more than 5 voxels.

Results

Emotional adjectives compared to neutral words yielded significantly deminished hemodynamic responses within the bilateral inferior frontal cortex and the left superior frontal gyrus in depressed patients (Figure 1).

Considering the different emotional aspects (pleasant, unpleasant) only the contrast unpleasant > neutral revealed a significant difference between patients and healthy controls (Figure 2). Patients exhibited a higher BOLD response in the right frontal pole of the temporal lobe. For this comparison healthy controls did not show any elevated activation.

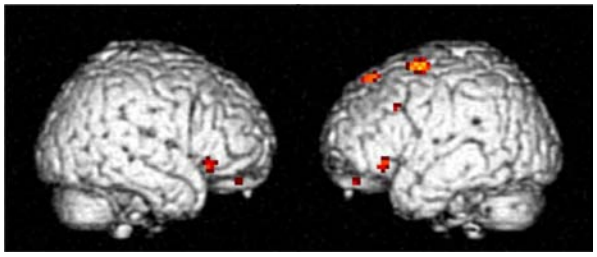

Figure 1: HC > Pat for emotional relative to neutral words

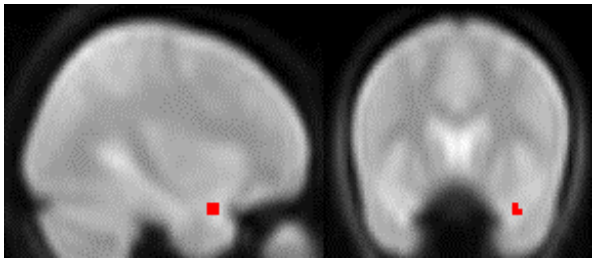

Figure 2: Pat > HC for negative relative to neutral words overlaid on mean image of all individual EPI images. The significant difference is located in the right frontal pole of the temporal lobe.

Conclusion

The findings reveal differences in brain activation patterns between depressed patients and healthy controls during passive reading of emotional adjectives. The pattern of the activation differences suggests, that for valence independent processing frontal regions show more activation indicating explicit evaluation in healthy controls. Valence specific differences were not found for controls but for patients. They show valence specific effects in subcortical regions probably indicating implicit processing.

In our small samples of depressed patients and healthy controls we corroborated the finding of Elliott et al. showing a preferential processing of negatively toned or charged adjectives in the temporal poles of depressed patients.

References

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