

Does the task make a difference? Comparison of active and passive processing of emotional words with functional neuroimaging

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Introduction

The purpose of this fMRI study was to find out whether active processing of the emotional valence of adjectives leads to an activation of different brain regions than passively reading does. Neuronal activation of emotional words has been investigated in different contexts. Words vary from adjectives [4] and nouns [1,2] with positive, negative and neutral valence, adjectives describing personality traits [3] to nouns dealing with social or physical threat [5]. Different tasks are used e.g. passively reading, evaluation of the valence and lexical decision task. The influence of the task on neuronal activation, especially on brain regions responsible for emotional processing is not known so far.

Methods

12 healthy participants underwent the passive reading condition and 10 subjects the active processing condition. All were right-handed and native speakers of German and gave written informed consent. The subjects of the passive condition were instructed to read the presented words silently. The subjects of the active processing group had to respond to the valence of the adjective by pressing different buttons corresponding to emotional valence. 3 x 34 highly arousing pleasant and unpleasant and low arousing neutral adjectives were randomly visually presented for 1 second with an interstimulus interval of 9 (\pm 2) s for the passive task and 4 (\pm 1) s for the processing task. 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, 64² matrix) were acquired in a 1.5 T Siemens Magnetom Vision Scanner. Statistical analysis was performed with SPM2. For each individual the following contrasts were assessed: word > baseline, emotion > neutral, pleasant > neutral and unpleasant > neutral. To evaluate differences between the two tasks individual t-contrast images were entered in a second level analysis (two sample t-test). Differences were considered statistically significant for a value of $p < 0.001$ (uncorrected for multiple comparison) and a cluster size of more than 10 voxels.

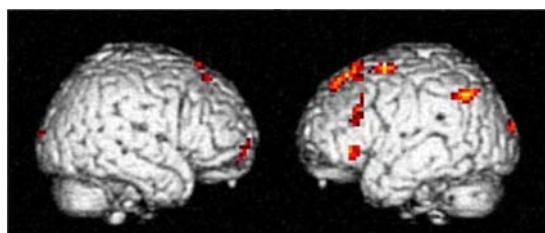


Figure 1: passive reading task, negative > neutral words

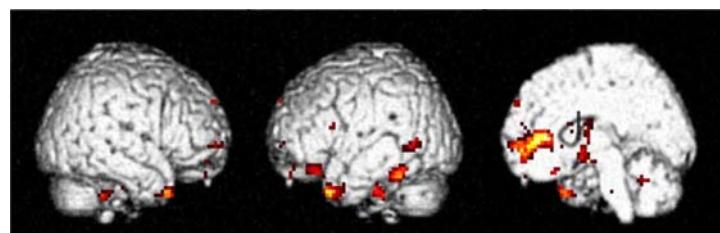


Figure 2: active evaluation task, negative > neutral words

Results

One sample t-tests for the two samples revealed greatest activation differences for the negative > neutral contrast in both samples. For the passive task negative adjectives yielded stronger activation in the left inferior frontal gyrus, left superior frontal gyrus and the left inferior parietal lobe (Figure 1). For the active task an elevated BOLD response was seen in the anterior cingulate cortex and the medial frontal gyrus and to a smaller extent in the anterior poles of both temporal lobes (Figure 2). Significant differences in the BOLD response between the two tasks occurred only for words compared to baseline. Subjects that evaluated the valence of the word and responded contingent to this evaluation had higher BOLD responses in left and right precuneus and in both parietal and occipital lobes. Aside from the difference in the left precentral gyrus and the cerebellum, indicating the motor response, significant differences occurred in the right thalamus and the medial frontal gyrus. For the other contrasts pleasant > neutral and unpleasant > neutral indicating the processing of the emotional valence of the adjectives no significant differences were seen.

Conclusion

Activation differences in precuneus and parietal regions seem to be a consequence of the elevated attention required for the evaluation of the valence and the faster presentation of the stimuli.

For the “emotional processing contrasts” we could not find any significant difference between the two processing tasks. The limitations of the study are located in the different inter-stimulus intervals and the inter-individual comparison. Additional evidence for this results will be obtained with an intra-individual design in which each subject has to execute both tasks.

References

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