

AFFECTIVE CONTEXT AFFECTS THE RESPONSE OF THE FUSIFORM GYRUS: FMRI INVESTIGATIONS OF THE FACE PROCESSING NETWORK IN ADOLESCENCE

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INTRODUCTION

Emotion processing is crucial for normal emotional development and for subsequent social interaction and functioning. The ability to decode facial expressions is an important component of social interaction because of the significant role of facial information in the appropriate modification of social behaviours [1-2]. However, the development of these processes and of the neural systems associated with this over the childhood and the adolescence period remains surprisingly underexamined, particularly because abnormalities in emotion expression recognition processing in adolescence are often associated with psychopathology in adult and child populations [3-5]. Moreover, understanding cognitive top-down effects during affective processing is of relevance as these mechanisms may modulate the response of the face processing network. In this study we evaluated differential top-down effects on the modulation of the face processing network. Young subjects performed a modified contextual continuous performance task CPT (Figure 1) with rapidly (250ms) presented faces with "X" or "A" overlaid on the bridge of the nose of each face. Each block of faces (30s) was tagged to denote the affective context under which the "X" was a target. This notable innovation allowed us to investigate modulation of the face processing network by top-down effects.

METHODS

30 healthy subjects aged between 13 and 21 years old were recruited and tested by means of the Mini-International Neuropsychiatric Interview (M.I.N.I.) [6] to exclude a psychiatric disorders (20 males, mean age 18.08 ± 1.84 years old). Each MR session was carried out with a 3T Achieva RM scanner (Philips) and a standard head coil. The MR protocol consisted of one anatomical sequence 3D T1-weighted (voxel size: $1 \times 1 \times 1$ mm) and one functional acquisition of 10,43 minutes performed with a T2*-weighted EPI sequence (TR/TE: 2000/30, In-plane resolution: 3.75×3.75 mm, Thickness: 3.8 mm, Nr of slices: 30, Field of view: 64×64 mm, Nr of volumes: 313). Figure 1 depicts the task: items (targets, e.g. "X" and distracters, e.g. "A") were rendered on a set of happy, fear, and neutral faces (obtained from the Ekman and Friesen series [7] happy, fear, and neutral picture sets) and distorted (scrambled) images (obtained from the Ekman and Friesen series disgust picture set). Each face had two images: one with an "X" over the nose and the other with an "A" over the nose. The status of the target was dependent on the affective context in which it was rendered. For example, under conditions of "negative valence", an "X" became a target if it was rendered on a face with negative valence but not otherwise. To all the subjects was asked to push a button only in the case of a target (a face with an "X" depending on the context). The task was organized in 11 blocks: 4 blocks of 54 seconds with images positive, distorted, negative and neutral (each of them was repeated two times) and 3 blocks of 30 seconds of rest. In each image block there was the 66.7% of target and the 33.3% of non-target. Imaging data were analyzed with SPM8 [8] (<http://www.fil.ion.ucl.ac.uk/spm/>). fMRI preprocessing included: 3D head-motion correction, slice-scan time correction, spatial smoothing of 6 mm FWHM, temporal high pass filter and linear trend removal. Anatomic 3D data set was segmented, normalized and coregistered with the functional information. The statistical analysis was conducted considering the 5 kind of blocks and not by using the images as separated: the contrasts between the blocks were thus analyzed. The group analysis was performed by using a t-test and by using age and sex as covariate. The resulting activations were analyzed by means of the minimum cluster size thresholding of AFNI Alphasim [9] (<http://afni.nimh.nih.gov/>) and the SPM Anatomy Toolbox v1.8 [10].

RESULTS

The resultant activation found in the Positive, Neutral and Negative blocks showed a similar involvement of the visual cortex, fusiform gyrus, left hippocampus, left insula and right superior parietal lobe. The subtraction Positive > Neutral didn't show any significant cluster. Conversely, the subtraction Negative > Positive showed three significant clusters (see in Figure 2 the numerated clusters). The cluster 1 involves the right visual cortex (right hOC4v V4, right hOC3v V3v, right hOC5 V5), the right fusiform gyrus, the right middle temporal gyrus and the right middle occipital gyrus. The cluster 2 implies the left visual cortex (left hOC4v V4, right hOC3v V3v, right hOC5 V5), the left fusiform gyrus, the left inferior occipital gyrus and the left middle occipital gyrus. Finally, in the cluster 3 it is possible to see the right area 44 and 45, the right inferior frontal gyrus and the right insula lobe.

DISCUSSION

These preliminary results suggest that adolescents have a particular involvement in emotion processing of facial expressions. While in the adult functional neuroimaging studies have highlighted that the top-down control during emotional face processing was shown to modulate the activity within the amygdala, occipito-temporal visual cortex, orbitofrontal and posterior cingulate cortex, independent of the emotional valence [11-12], in the case of adolescents the fusiform gyrus plays an important role. Some studies have associated depressed patients with a reduced pre frontal cortex (PFC) activity as well as hyperactivity within the amygdala, parahippocampal gyrus and fusiform gyrus in response to negative stimuli. Probably the hyperactivity is due to a reduced top-down control of the PFC over the limbic areas due to a serotonin-induced modulation [13-14]. The adolescents seems to have a reduced top-down control that produce a greater activation of the fusiform gyrus while is displayed a negative face in contrast of a positive face. Moreover, the amount of the involvement of the total activation is the same for positive and neutral faces. These findings show that, by means of fMRI, it is possible to isolate difference in the top-down effects on the modulation of the face processing network in the adolescence and it is different depending on the expression. These findings will help to better understand the top-down effects on the face processing network and aid the development of earlier interventions for children and adolescents with psychiatric disorders.

REFERENCES

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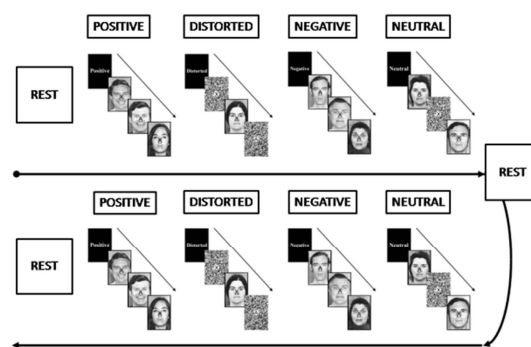


Figure 1: CPT Task.

