fMRI correlates of abmnormal 'guilt processing' in patients with obsessive compulsive disorder

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Introduction

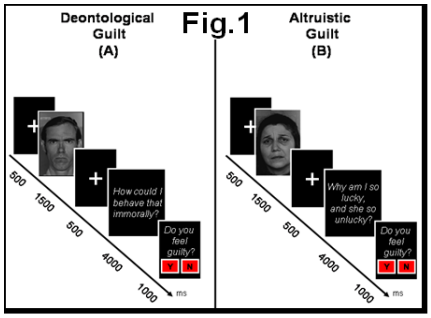
Guilt appears to play a role in the occurrence and maintenance of obsessive compulsive disorder (OCD) (1, 2). In a recent fMRI investigation (3), we demonstrated that, in healthy individuals, deontological guilt (DG) (i.e., feeling deriving from violating one's own interior moral values) and altruistic, or survivor, guilt (AG) rely on the activation of specific neuronal networks. Activation in the anterior cingulate cortex (ACC) and in the left insula is modulated by DG stimuli, while medial prefrontal areas (that are traditionally involved in the Theory of Mind; 4) respond more to AG stimuli. The aim of the current fMRI study is to assess whether the role postulated for guilt in OCD is supported by an abnormal processing of guilt, and more specifically of DG (1).

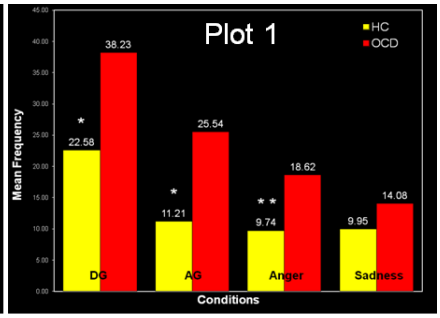
Methods

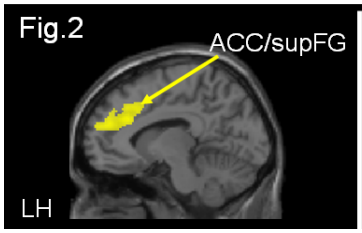
Thirteen patients with OCD (F/M 3/10; mean [SD] age=37 [11.1]) and 19 healthy controls (HC) (F/M 8/11; mean [SD] age=26.2 [2.1]) were recruited for this fMRI experiment at 3T. Psychological tools to assess/exclude the presence of OCD symptoms, and to quantify the attitude of experiencing guilty feeling were administered to all subjects. The event-related emotional paradigm validated in our previous study (3) was employed here. The paradigm is based on the presentation of specific stimuli (face expressions followed by contextual sentences), previously shown to selectively induce AG or DG feeling (Figure1). Stimuli evoking anger and sadness (basic emotions) were also randomly presented and used as control conditions for DG and AG respectively. After each stimulus presentation, subjects were requested to indicate, by button pressing, whether they experienced or not guilty feeling. T-tests for independent samples were used to compare between groups fMRI behavioural responses. FMRI data were processed using SPM5 and analyzed with the general linear model for event-related designs. At first level analysis, the two target conditions (AG and DG) and the two correspondent control conditions (anger and sadness) were modelled. For second level group' comparison a flexible factorial design was employed, including all experimental conditions.

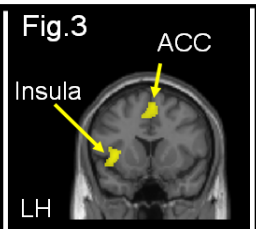
Results

Psychological tools confirmed the diagnosis of OCD in all patients and excluded any abnormality in HC. Moreover, this assessment confirmed an higher attitude of OCD patients in experiencing guilt. Consistently, behavioural responses in fMRI experiment revealed that OCD patients felt significantly more guilty in both DG and AG conditions, when compared to HC [t(30) = -2.33, p < 0.02, in DG; t(32) = -2.78, p < 0.009, in AG. See means in Figure 1)]. Patients also rated anger stimuli as more guilt-inducing than HC, although this result did not reach full statistical significance (p < 0.06). Conversely, no differences in guilt-ratings were observed in the sadness condition. When considering fMRI results, guilt conditions compared against their controls (i.e. anger and sadness) revealed significant decrease of activity in the anterior cingulate cortex (ACC) and in the superior Frontal Gyrus (supFG) of OCD patients compared to HC (Figure 2). When separately considering each type of guilt (against each of its control), OCD patients compared to HC showed decreased activation in the ACC, in the left insula, and in the precuneus bilaterally (Figure 3), for DG. Conversely, no significant group difference was observed in AG. Interestingly, OCD patients activated more than controls in response to both basic emotions (control conditions): anger induced greater activation in the left superior Temporal Gyrus (Figure 4), while sadness activated more the left occipital cortex (x, y, z = -12, -76, -10, Z=4.02) in sad condition.









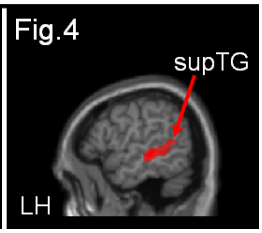


Figure 1. fMRI paradigm. The timing of each event in each trial is illustrated schematically. Each trial included the presentation of an emotional or neutral face, followed by a contextual sentence. The content of the sentence leads to two types of guilt (DG and AG) and two control conditions (anger and sadness) (Basile et al., 2011).

Table 1. OCD patients reported significantly more guilty feelings in both guilt conditions when compared to HC. * p<0.05; ** p<0.06.

Figure 2. Increased brain activation in HC, vs patients, in both guilt conditions against their controls. BOLD signal changes within the anterior cingulate cortex (ACC; Talairach coordinates: x, y, z = 8, 24, 32, Z=3.79; cluster level p-corr. = 0.000), extending to the superior Frontal Gyrus (supFG; x, y, z = -6, 30, 30, Z=3.76), are shown.

Figure 3. For DG, patients compared to HC, showed decreased activation in the ACC (x, y, z = -2, 18, 46, Z=3.95; cluster level p-corr. = 0.02), in the insula (x, y, z = -38, 12, 2, Z=3.54) and precuneus (x, y, z = -10, -66, 50, Z=3.95).

Figure 4. Patients activated more than controls in the anger condition in the left superior Temporal Gyrus (supTG; x, y, z = -56, -26, -4, Z=4.80; cluster level p-corr. = 0.01) .

Discussion

OCD patients reported more guilty feelings on psychological assessments, as well as during fMRI task performance. fMRI results suggest that patients have reduced activation in the ACC and in the superior frontal gyrus, when experiencing guilt, regardless of its specific type (DG or AG). In line with our previous hypothesis where we describe guilt as a more cognitively structured emotion (3), this suggests a release of inhibition of these areas on more basic emotion circuits. Consistently previous literature (1), an abnormal processing of DG, but not of AG, is distinctive of OCD patients. According to previous investigations based on eliciting basic emotions (5), OCD patients activated more than HC for stimuli inducing anger and sadness. Again, this suggests a release of inhibition of higher-level control structures on brain areas more directly associated to basic emotion processing. In conclusion, our findings suggest that OCD might depend on the release of inhibition on neuronal circuits subserving a specific complex emotion (such as DG) patients' are more vulnerable to. Over-reaction to basic emotions, such as anger and sadness, might also be explained by a release of inhibition, and might contribute to OCD clinical features.

References

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