Neural correlates of habitual expressive-suppression in trauma-exposed individuals

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Target audience: Those interested in clinical neuroimaging and affective neuroscience.

Purpose: Expressive-suppression is a response-focused affective regulation strategy which involves the modulation of outward signals of emotion 1. This suppression based strategy is less effective than other emotion regulation strategies (e.g. reappraisal) at regulating affective responses to negative stimuli. Moreover, habitual use of this strategy is associated with impaired mental health and increased PTSD symptoms following exposure to stress and trauma 2. Previous work has examined the neural correlates of instructed emotional suppression in healthy controls and has reported a role for increased insula activation 3,4. Moreover, structural MRI work implicates insula abnormalities in habitual users of suppression 5. Only one study has examined the functional correlates of habitual expressive-suppression to affective stimuli. This study found decreased vMPFC activation in frequent suppressors amongst depressed subjects 6.

Despite the importance of understanding emotion regulation abnormalities in trauma-exposed individuals, no studies have yet used functional neuroimaging to investigate habitual emotion regulation styles in this disorder. The purpose of this study was to provide a first exploration of the neural correlates of habitual expressive-suppression in response to negative affective stimuli in trauma-exposed individuals. On the basis of previous research, we expected that a tendency to use expressive-suppression would positively correlate with insula activation, and negatively correlate with mPFC activation, in this population.

Method: Thirty-five right-handed trauma-exposed individuals successfully completed the study. Of these, data for one participant was excluded to signal drop-out caused by an ear ring, leaving a final sample of N=34 (8 males, 26 females). More than 91% of the sample met the DSM-IV diagnostic criteria for sub-syndromal PTSD (14.7%) or full PTSD (76.5%).

Scanning was conducted at the Exeter MR Research Centre using a 1.5-T Philips scanner fitted with an eight-channel SENSE head coil, and a T 2*-weighted echoplanar imaging (EPI) sequence. For each participant, functional data were overlaid on a high resolution T1-weighted anatomical image for registration into standard space and functional localisation (3D T1 FFE, TR = 25 ms, TE = 4.5 ms, Voxel size = 0.9x9x1.6 mm3). Number of Slices = 160, FOV = 230 mm, flip angle = 90 degrees.

Prior to the scanning session, participants completed a measure of current PTSD symptomatology 7. Analysis was conducted in FSL (FMRIB’s Software Library). At the single subject-level, the onset of the emotional faces condition was modelled as a box-car regressor, with the shape-matching condition modelled implicitly as a baseline. At the higher level, we first analysed the mean areas of activation within our group to the emotional faces versus shapes. Following this, in order to examine which regions showed activation that correlated with self-reported use of expressive-suppression, we ran a whole-brain regression analysis using scores on the ERQ-suppression subscale and controlling for current PTSD, anxiety and depressive symptoms and scores on the ERQ-cognitive reappraisal subscale. Due to a priori hypotheses regarding the role of the insula in expressive-suppression, we also conducted planned analyses using hemisphere-specific anatomical insula regions of interest (ROIs). These ROIs were extracted from the Harvard-Oxford probabilistic cortical atlas, thresholded at 25% probability and binarized.

Results: At the whole brain level, participants activated regions previously implicated in this task, including visual cortex, the amygdala and DLPFC. Regarding our correlational analyses, scores on the expressive-suppression subscale of the ERQ correlated negatively with activation to emotional faces within the mPFC and thalamus, and correlated positively with activation in supplementary motor cortex and visual cortex. Moreover, within our left insula ROI we found a significant cluster where activation correlated positively with expressive-suppression scores.

Discussion: In support of our hypotheses, trauma-exposed participants who reported habitually using expressive-suppression showed decreased activation in the mPFC and increased insula activation in response to emotional material. Our finding of decreased medial prefrontal cortex activation in trauma-exposed habitual suppressors is in line with a recent study which found similar results in a group of depressed patients 8. This region of the prefrontal cortex is implicated in automatic, nonconsciously regulated affect and is impaired in PTSD 9,10. Our current findings may suggest that increased use of expressive-suppression in individuals with post-traumatic symptoms is a compensatory attempt at affective regulation, following failures of mPFC mediated regulatory systems.

In common with previous studies of instructed expressive-suppression, we found that habitual expressive-suppression was associated with activation to emotional stimuli in the insula, which is also an area that has been implicated in PTSD 11. This finding suggests that expressive-suppression assessed during instructed regulation paradigms is subserved by the same neural substrate as more naturalistic uses of this regulation strategy. Moreover, expressive-suppression requires the monitoring of affect-related physiological responses and subjective affective experience. The insula is heavily implicated on interoception and appraisals of subjective experience 12,13, and it is therefore likely that its heightened activation represents an increased monitoring of psychophysiological responses to affective stimuli in habitual suppressors.

Conclusion: Our current finding of decreased medial prefrontal activation to emotional material in habitual users of expressive-suppression amongst trauma-exposed individuals is in contrast to the use of other forms of suppression (e.g. reappraisal) mediated top-down emotion regulation in this population. Moreover, our finding of a positive correlation between habitual expressive suppression and insula activation to emotional material suggests that previous reports of insula hyperresponsiveness in trauma-exposed individuals may result from increased utilisation of expressive-suppression as a compensatory regulatory strategy in this population.

Figure 1:

(A) Shows region in the mPFC where scores on the ERQ-suppression subscale negatively correlated with activation during emotional face matching (Z>2.1, p<.05, corrected).
(B) Shows a cluster in our left insula ROI where activity during emotional face matching was positively correlated with expressive-suppression scores (Z>2.1, p<.05, corrected).