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LETTERS TO THE EDITOR

Strong limbic and weak frontal activation to aggressive stimuli in spouse abusers

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Spouse abuse, listed as a V code (V61.12) in DSM-IV, has been viewed almost exclusively from a social perspective. In this functional magnetic resonance imaging (fMRI) study, we observed that batterers, relative to controls, show more limbic and less frontal activation to aggressive stimuli. No group differences in brain activation to stimuli lacking an affective component were observed. The findings suggest that inadequate prefrontal and anterior cingulate resources to exercise top-down regulatory control over the excessive limbic activation to aggressive stimuli may in part explain the functional brain abnormality of batterers.

As the predominating view of spouse abuse is that it constitutes a rational act aimed at regulating conflict,[1] the possibility exists that it may have a neurobiological component.[2] The literature suggests that emotional regulation is subserved by a network of brain regions including the prefrontal cortex, amygdala, hippocampus, hypothalamus, anterior cingulate cortex, insular cortex, ventral striatum and other interconnected regions. The suppression of negative emotion is achieved via an inhibitory connection between the frontal and limbic regions.[3,4] Therefore, any functional or structural abnormalities in one or more of these regions or their interconnections would be expected to increase the propensity for impulsive aggression due to the unsuccessful suppression of negative emotion. In accordance with this line of thought, one neurophysiological model of spouse abuse is that a combination of subcortical hyperreactivity to negative affect stimuli combined with insufficient prefrontal regulatory resources results in emotion dysregulation and a predisposition to reactive aggression. To test this hypothesis, 10 male

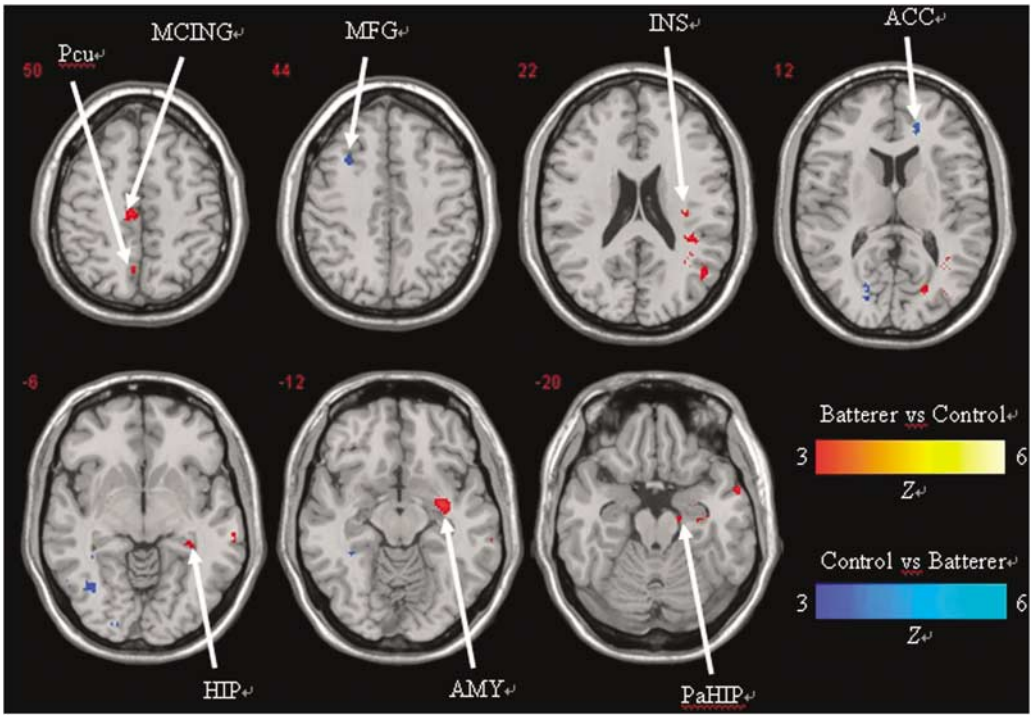

Figure 1 Activation maps of the between-group comparison for the aggressive versus neutral words on the emotional Stroop task. Group data were thresholded with cluster correction at $P<0.005$, cluster size >10 voxels. Red numbers at top left denote the *z* axis (in mm) of the displayed slice. Left is left. Anatomical labels: ACC, anterior cingulate; AMY, amygdala; HIP, Hippocampus; INS, insula; MCING, middle cingulate; MFG, middle frontal gyrus; PaHIP, parahippocampal gyrus; Pcu, precuneus.

batterers and 13 male matched controls performed the cognitive[5] and emotional[6] Stroop tasks carried out in a block design while having their brain activities monitored by a 3T Philips Achieva scanner. The behavioral data showed that, on the emotional Stroop task, batterers were relatively slower in responding to negative affect stimuli compared to neutral stimuli, $F(1,21) = 5.28$, $P = 0.03$, $\eta^2 = 0.20$. However, no significant group-by-condition interaction was observed for the cognitive Stroop task, $F(1,21) = 0.75$, $P = 0.40$, $\eta^2 = 0.04$.

For the fMRI experiment, a single-shot T2*-weighted gradient echo planar imaging sequence was used for the fMRI scans (slice thickness = 4 mm with 1 mm gap; in plane resolution = 1.8 mm^2; FOV = 230 mm^2, matrix = 128 mm^2 and TR/TE/θ = 4000 ms/30 ms/90°). Thirty-four contiguous slices oriented perpendicular to the Sylvian fissures were acquired to cover the whole brain. The anatomical MRI was acquired using a T1-weighted, three-dimensional, gradient-echo pulse sequence. There were two runs in total and each run consisted of three blocks presented in a pseudo-randomized order: one block for neutral words, one block for color words and one block for aggressive words. The inter-block interval was 20 s. Each block consisted of 10 trials. Target words within each block were presented in a randomized order.

The fMRI data were analyzed using SPM2.[7] The findings showed that batterers, relative to controls, showed less activation of the left middle frontal gyrus, right anterior cingulate gyrus, left calcarine fissure, left lingual gyrus, left fusiform and left middle and inferior temporal gyri when responding to aggressive words. On the other hand, they showed activations of the right amygdala, right hippocampus, right parahippocampal gyrus, right insula, right calcarine fissure, right middle occipital gyrus, right fusiform, right superior and middle temporal gyri, right caudate nucleus, left middle cingulate gyrus and left precuneus when responding to aggressive words (see Figure 1). No significant group difference in brain activation was observed for the main contrast of the cognitive Stroop task.

This study represents a first step toward testing the hypothesis of a neurobiological contribution to spouse abuse. The findings give rise to the provisional hypothesis that when exposed to aggressive stimuli, batterers have inadequate prefrontal resources to exercise top-down regulatory control over the excessive limbic activation generated by negative stimuli. This processing bias appears to be selective in that it does not generalize to affectively neutral stimuli. The findings suggest (but do not prove) that the violent acts committed by batterers against their partners may in part be explained by a functional brain abnormality, that the relative balance of activity between the cortical and the subcortical regions is important in the inhibition of aggressive behavior, and that reduced prefrontal but increased limbic activation could predispose to unbridled, dysregulated aggression.[8]

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Altered prepulse inhibition in mice with dendrite abnormalities of hippocampal neurons

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Deciphering sensory gating mechanisms may give clues to some of the neurophysiological deficits present in mental disorders. Here, we report an alteration of prepulse inhibition (PPI) and dendrite abnormalities of the hippocampus in mice with targeted disruption of the collapsin response mediator protein-3 (CRMP3) gene.

Sensorimotor gating deficits, by allowing irrelevant thoughts and sensory stimuli into conscious awareness, may contribute to the etiopathogeny of