Cortisol levels as index for vulnerability to stress

Stress exposure is known to precipitate psychological disorders. However, large differences exist in how individuals respond to stress; whereas some people thrive under stressful situations, others break down and are at risk to develop psychopathology. One important characteristic in stress-related mental disorders is the abnormal functioning of the hypothalamus–pituitary–adrenal (HPA) axis, generating aberrant levels of the stress hormone cortisol in ones' brain and body. This suggests that variability in HPA-axis activity might play a role in the vulnerability to mental disease.

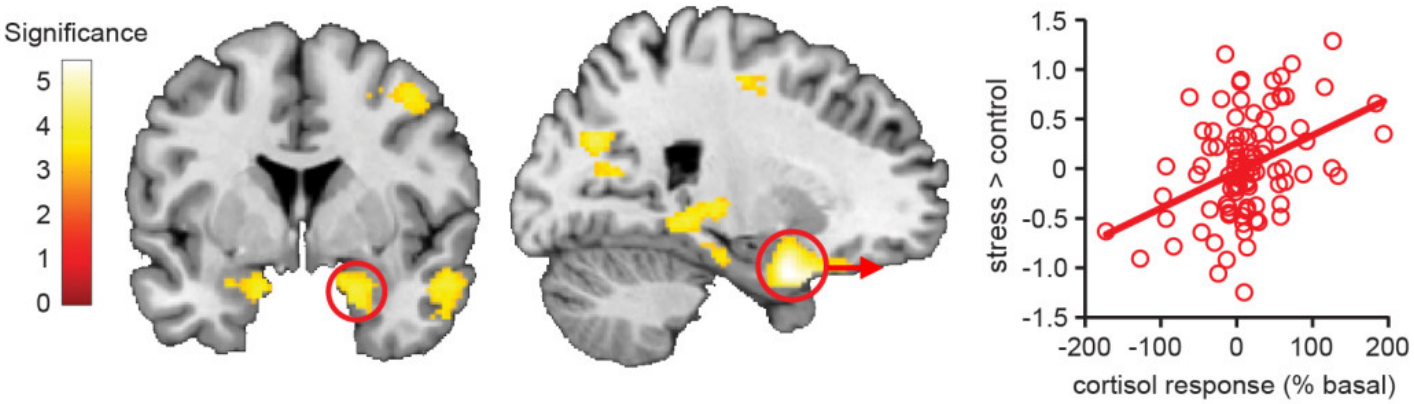

Fig. 1. Activity of the amygdala, the key modulator of vigilance and emotional processing in the brain, increased in response to stress depending on an individuals cortisol response to the stressor. Participants with high cortisol responses showed much stronger stress-induced increases in amygdala activation than those with low responses.

In this study, we investigated how healthy inter-individual variation in cortisol levels, both basally (i.e., under resting conditions) and in response to stress, predicts differences in the brains' processing of emotional information under stress. Therefore, we asked 120 healthy male volunteers to watch faces with fearful and happy expressions in the MRI-scanner twice; once after being exposed to a highly aversive movie clip, and once after seeing a neutral control movie clip. Participants' stress sensitivity was assessed by comparing physiological markers (heart rate, blood pressure, and salivary cortisol levels) and psychological measures (questionnaires) in following the two different movies. Next, we checked how these stress measures corresponded to their brain processing of the emotional faces under stress.

We found that participants with relatively high *stress-induced* cortisol responses were less extravert and displayed higher levels of depressive symptoms than those participants with low stress-induced cortisol responses. Moreover, under control conditions, these individuals showed stronger responses to fearful as opposed to happy faces in the amygdala, the key regulator of vigilance and emotional processing in the brain. Furthermore, they showed a strong increase in neural activity of

the medial temporal lobe, a region involved in emotional processing and memory, under stress.

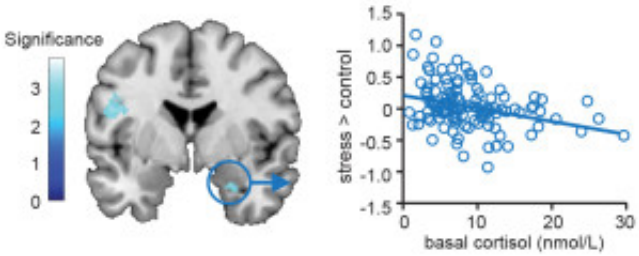

Fig. 2. Basal cortisol levels were negatively correlated with the stress-induced activity of the amygdala. Participants with low basal cortisol levels showed much stronger increases in amygdala activity due to stress than those with high basal levels, indicating their relative stress resilience.

In contrast, high *basal* cortisol levels seemed to be related to relative stress resilience. Participants with high basal levels had higher extraversion scores and a lower increase in amygdala activity during stress, indicating a less emotional response. Moreover, they showed stronger specific processing of fearful compared with happy faces under stress, beneficial under conditions of threat.

All together, these findings indicate a critical role for HPA-axis signaling in stress coping; higher basal cortisol levels seemed to reflect stress resilience, whereas higher stress-induced cortisol responsivity in those individuals prone to react sensitively to stress might be necessary for adequate recovery.

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Publication

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