# Neural Correlates of Acute Induced Stress

# and Decision-Making under Risk: an fMRI Study

**Revati Mulay 1,2, Niels Doehring 1,2, Peter Erhard 1, Negin Javaheri 1,2, Manfred Herrmann 1,2**

**Abstract**

**Introduction:** The impact of stress on decision-making under risk has been assessed in several behavioral studies which have led to inconsistent findings. The discrepancies in behavioral results might be investigated further by assessing modulators of stress processing and risky decision-making with neuroimaging approach. However, there is a lack of studies assessing neural correlates of acute induced stress and its impact on decision-making under risk. Therefore, the present functional magnetic resonance imaging (fMRI) study assessed the neural correlates of decision-making under risk pre- and post-stress.

**Methods:** The study introduced a within-subject design with 40 right-handed young adults with no neurological or mental impairments (18 males, *M*= 24.6 years, *SD* = 3.9 years).

Participants performed the respective ‘decision-making under risk’ task twice in a counter-balanced manner: once immediately following stress induction, and once after a control task that does not involve any stress induction. Stress was induced by asking participants to solve mental arithmetic tasks under time pressure with the threat of receiving harsh negative feedback. Stress induction was measured with a 10-point self-reported scale, with 0 implying no stress at all and 10 implying extreme levels of stress. During the decision-making under risk task, participants performed binary lottery decisions between a safe and a risky option with known probabilities of winning prior to the respective decisions.

**Results:** Behavioral data confirmed that the stress induction was successful (*t*(39) = 11.1, *p* < .001). Furthermore, participants’ math performance as measured by the percentage of correct answers was significantly lower during the stress condition as compared to the control condition (*t(*39) = 16.4, *p* < .001), and participants took less risky decisions post-stress than post-control (*t*(39) = 2.4, *p* = .02). The fMRI contrast analysis revealed that the pre-frontal cortex, particularly middle frontal gyri exhibited significantly lower activation during decisions post-stress than decisions post-control (*T* => 3.6, *p* < 0.001, cluster size >= 100 voxels).

**Conclusion:** The current study established novel paradigm with a minimal stress-to-task latency to assess neural correlates of risky decision-making post-stress. The results indicate that decisions post-stress are risk-averse and are associated with pre-frontal cortex inhibition.

*1: Department of Neuropsychology and Behavioral Neurobiology, University of Bremen, German*

*2: Affiliation with DFG funded graduate program “KD2 School: Designing Adaptive Systems for Economic Decision-Making*” (DFG-GRK 2739)