

## Acute stress selectively impairs learning to minimize effort

abstract

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### Abstract

**Background:** Exposure to stress has consistently been associated with the development of psychiatric disorders. One transdiagnostic symptom often present in disorders associated with stress exposure, including depression and schizophrenia, is aversion towards expending cognitive or physical effort, thought to impact goal-directed behaviour. How acute stress affects effort-cost computations in humans, however, has not been investigated to date.

**Methods:** 40 healthy humans aged 18-30 were (randomly) exposed to the Maastricht Acute Stress Task stress (2°C water, arithmetics, negative evaluative feedback) or no-stress control condition (n=20 per group). Next, all participants completed an instrumental learning paradigm during which they learned to select images associated with frequent monetary rewards and/or to avoid images with high effort cost (2.5s of pre-calibrated maximum grip force).

**Results:** Acute stress was associated with a selective reduction in learning to minimize effort, while learning to maximize reward remained unaffected (group-by-trialtype interaction  $F=5.174$ ,  $p=.031$ ; trialtype main effect in stress condition  $t=3.99$ ,  $p=.001$ ). Greater cortisol area-under-the-curve measures were trend-level associated with smaller differences between reward and effort learning ( $r=-.48$ ,  $p=.08$ ). We employed computational modelling to formally link stress-induced performance deficits to changes in effort-cost and reward sensitivity.

**Conclusions:** Here we show for the first time that exposure to stress has marked effects on learning to minimize effort. These results provide formal mechanisms linking stress exposure to alterations in the ability to avoid effort, relevant to psychiatric disorders associated with altered goal-directed behaviour. Future analyses of pupillometry and physiological stress data can provide first insights into neurochemical mechanisms that may mediate these effects.