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Bayesian decision-making under stress-preserved weighting of prior and likelihood information

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A rich body of empirical work has addressed the question of how stress changes the way we memorize, learn, and make high-level decisions in complex scenarios. There is evidence that stress also changes the way we perceive the world, indicating influences on decision-making at lower levels. Surprisingly, as of yet, little research has been conducted in this domain. A few studies suggest that under stress, humans tend to eschew existing knowledge, and instead focus on novel input or information from bottom-up. Decision-making in the perceptual domain has been modeled with Bayesian frameworks. Here, existing knowledge about structures and statistics of our environment is referred to as *prior*, whereas sensory data are termed *likelihood*. In this study, we directly assessed whether stress, as induced by the socially evaluated cold pressure task (SECPT), would modulate low-level decisions, specifically the weight given to sensory information, and how people reacted to changes in prior and sensory uncertainty. We found that while the stress-inducing procedure successfully elicited subjective stress ratings aswell as stress relevant physiological paramters, it did not change participants' average reliance on sensory information. Furthermore, it did not affect participants' sensitivity to changes in prior and sensory uncertainty, with both groups able to detect it and modulate their behavior accordingly, in a way predicted by Bayesian statistics. Our results suggest that, contrary to our predictions, stress may not directly affect lower-level sensory-motor decisions. We discuss the findings in context of time scales of the stress reaction, linked to different neural and functional consequences.

Stress is a ubiquitous phenomenon in our world, and its effects on health and cognition, the underlying neural networks, and physiological mechanisms are subject to intense empirical investigations. Enhanced memory for stressful events as well as impaired retrieval from long-term memory has been in the focus of scientific endeavors[1]. Additionally, a plethora of studies examined modifications of working memory functioning during stress and current evidence points to an impairment in memorizing over the short-term[2,3]. Possibly, stress impairs functioning of this faculty by altered processing of Dopamine 1 (DA1) receptors induced by glucocorticoids[4]. The DA1 receptors seem to be vital for prefrontal cortex (PFC) functioning, presumably for task-related, reverberatory activity during the maintenance of information in animals and humans[5,6]. However, the question of whether and how low-level decision-making is affected has been much less explored. In the locus coeruleus, a shift from a phasic towards a tonic mode of activity has been reported under stress, thus in principle able to promote enhanced saliency detection, possibly via an increase in sensory gating capacity[7]. When exposed to a rapid stream of sensory data, participants usually miss a second target that is presented maximally 500 ms after the first one, referred to as the *attentional blink*[8]. This effect has been explained by attention being allocated to the processing of the first target, thus leaving no capacity to process the second target. The attentional blink is reduced under conditions of stress[9]. This may be linked to a generally enhanced (in this context preserved) ability to process incoming sensory information, i.e., data from bottom-up, possibly at costs for top-down or prior information residing within the system. Another important finding is that in situations of acute stress, the functioning of the PFC is affected, possibly because the system switches to a bottom-up control by the sensory cortices[10]. Stress is also associated with impaired memory retrieval, as explained by the operation of glucocorticoids in dedicated brain areas[11]. An alternative, functional account of these effects may be that previously stored, prior information is no longer useful, and consequently, its access (adaptively) impeded. This may equal a cognitive strategy that actively eschews stored generative models about the environment, and instead gives more weight to sensory data, i.e., incoming information. There is also evidence that acute stress increases exploration

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