

Anger and Memory

Effects of stress on memory (Wikipedia)

(Quit smirking – this is actually a good summary of the issues)

The effects of stress on memory include interference with a person's capacity to encode memory and the ability to retrieve information.^{[1][2]} During times of stress, the body reacts by secreting stress hormones into the bloodstream. Stress can cause acute and chronic changes in certain brain areas which can cause long-term damage.^[3] Over-secretion of stress hormones most frequently impairs memory, but in a few cases can enhance it. In particular, the hippocampus, prefrontal cortex and the amygdala are affected.^{[4][5]} One class of stress hormone responsible for negatively affecting memory is the glucocorticoids (GCs), the most notable of which is cortisol.^{[1][5][6]} Glucocorticoids facilitate and impair the actions of stress in the brain memory process.^[7] Cortisol is a known biomarker for stress.^[8] Under normal circumstances, the hippocampus regulates the production of cortisol through negative feedback because it has many receptors that are sensitive to these stress hormones. However, an excess of cortisol can impair the ability of the hippocampus to both encode and recall memories.^[2] These stress hormones are also hindering the hippocampus from receiving enough energy by diverting glucose levels to surrounding muscles.^[2]

Stress affects many memory functions and cognitive functioning of the brain.^[9] There are different levels of stress and the high levels can be intrinsic or extrinsic. Intrinsic stress level is triggered by a cognitive challenge whereas extrinsic can be triggered by a condition not related to a cognitive task.^[7] Intrinsic stress can be acutely and chronically experienced by a person.^[7] The varying effects of stress on performance or stress hormones are often compared to or known as "inverted-u"^[9] which induce areas in learning, memory and plasticity.^[7] Chronic stress can affect the brain structure and cognition.

Studies considered the effects of stress on both intrinsic and extrinsic memory functions, using for both of them Pavlovian conditioning and spatial learning.^[7] In regard to intrinsic memory functions, the study evaluated how stress affected memory functions that was triggered by a learning challenge. In regard to extrinsic stress, the study focused on stress that was not related to cognitive task but was elicited by other situations. The results determined that intrinsic stress was facilitated by memory consolidation process and extrinsic stress was determined to be heterogeneous in regard to memory consolidation. Researchers found that high stress conditions were a good representative of the effect that extrinsic stress can cause on memory functioning.^[7] It was also proven that extrinsic stress does affect spatial learning whereas acute extrinsic stress does not.^[7]

1. de Quervain et al., Stress and glucocorticoids impair retrieval of long-term spatial memory. *Nature*, 394, 787-790 (1998)
2. Kuhlmann, S.; Piel, M.; Wolf, O.T. (2005). *"Impaired Memory Retrieval after Psychosocial Stress in Healthy Young Men"*. *Journal of Neuroscience*. **25** (11): 2977–2982. doi:10.1523/jneurosci.5139-04.2005. PMID 15772357.
3. Henckens, M. J. A. G.; Hermans, E. J.; Pu, Z.; Joels, M.; Fernandez, G. (12 August 2009). *"Stressed Memories: How Acute Stress Affects Memory Formation in Humans"*. *Journal of Neuroscience*. **29** (32): 10111–10119. doi:10.1523/JNEUROSCI.1184-09.2009. PMID 19675245.
4. Sandi, Carmen; Pinelo-Nava, M. Teresa (1 January 2007). *"Stress and Memory: Behavioral Effects and Neurobiological Mechanisms"*. *Neural Plasticity*. **2007**: 1–20. doi:10.1155/2007/78970.

Stress and glucocorticoids impair retrieval of long-term spatial memory.

de Quervain, Dominique J.-F., Roozendaal, Benno, McGaugh, James L.

Nature, Vol 394(6695), Aug, 1998. pp. 787-790.

Abstract:

Previous studies have focused exclusively on glucocorticoid effects on acquisition and long-term storage of newly acquired information. The present authors report that stress and glucocorticoids also affect memory retrieval. They show that rats have impaired performance in a water-maze spatial task after being given footshock 30 min before retention testing but are not impaired when footshock is given 2 min or 4 hrs before testing. These time-dependent effects on retention performance correspond to the circulating corticosterone levels at the time of testing, which suggests that the retention impairment is directly related to increased adrenocortical function. Supporting this idea is the finding that suppression of corticosterone synthesis with metyrapone blocks the stress-induced retention impairment. In addition, systemic corticosterone administered to non-stressed rats 30 min before retention testing induces dose-dependent retention impairment. The impairing effects of stress and glucocorticoids on retention are not due to disruption of spatial navigation per se. Results indicate that besides the well described effects of stress and glucocorticoids on acquisition and consolidation processes, glucocorticoids also affect memory retrieval mechanisms.

Impaired Memory Retrieval after Psychosocial Stress in Healthy Young Men.

Kuhlmann, Sabrina, Piel, Marcel, Wolf, Oliver T..

The Journal of Neuroscience, Vol 25(11), Mar, 2005. pp. 2977-2982.

Abstract:

Glucocorticoids (GCs) are known to modulate memory in animals and humans. One popular model suggests that stress or GC treatment enhances memory consolidation while impairing delayed memory retrieval. Studies in humans have documented that treatment with GCs impairs delayed memory retrieval. Similar alterations after exposure to stress have not been observed thus far. In the present study, 19 young healthy male subjects were exposed to either a standardized psychosocial laboratory stressor (Trier Social Stress Test) or a control condition in a crossover manner. After both treatments, retrieval of a word list (learned 24 h earlier) containing 10 neutral, 10 negative, and 10 positive words was tested. The stressor induced a significant increase in salivary free cortisol and a decrease in mood. Memory retrieval (free recall) was significantly impaired after the stress condition. Follow-up analysis revealed that negative and positive words (i.e., emotionally arousing words) were affected, whereas no effect was observed for neutral words. No changes were detected for cued recall, working memory, or attention. The present study thus demonstrates that psychosocial stress impairs memory retrieval in humans and suggests that emotionally arousing material is especially sensitive to this effect.

Stressed memories: How acute stress affects memory formation in humans.

Henckens, Marloes J. A. G., et. al.

The Journal of Neuroscience, Vol 29(32), Aug 12, 2009. pp. 10111-10119.

Abstract:

Stressful, aversive events are extremely well remembered. Such a declarative memory enhancement is evidently beneficial for survival, but the same mechanism may become maladaptive and culminate in mental diseases such as posttraumatic stress disorder (PTSD). Stress hormones are known to enhance postlearning consolidation of aversive memories but are also thought to have immediate effects on attentional, sensory, and mnemonic processes at memory formation. Despite their significance for our understanding of the etiology of stress-related mental disorders, effects of acute stress at memory formation, and their brain correlates at the system scale, remain elusive. Using an

integrated experimental approach, we probed the neural correlates of memory formation while participants underwent a controlled stress induction procedure in a crossover design. Physiological (cortisol level, heart rate, and pupil dilation) and subjective measures confirmed acute stress. Remarkably, reduced hippocampal activation during encoding predicted stress-enhanced memory performance, both within and between participants. Stress, moreover, amplified early visual and inferior temporal responses, suggesting that hypervigilant processing goes along with enhanced inferior temporal information reduction to relay a higher proportion of task-relevant information to the hippocampus. Thus, acute stress affects neural correlates of memory formation in an unexpected manner, the understanding of which may elucidate mechanisms underlying psychological trauma etiology.

Beyond general arousal: Effects of specific emotions on memory.

Levine, Linda J., Burgess, Stewart L.

Social Cognition, Vol 15(3), Fal 1997. pp. 157-181.

Abstract:

Examined the effects of happiness, anger, and sadness on participants' memory for different types of information in a narrative. Happiness and negative emotions were evoked in 263 undergraduates (aged 17–29 yrs) by randomly assigning grades of 'A' or 'D' on a surprise quiz. Immediately afterwards, Ss participated in what they believed to be an unrelated study during which they heard and recalled a narrative and described their emotional state. Ss in the positive emotion condition recalled more of the narrative as a whole than did Ss in the negative emotion condition. Analyses based on self-reported emotions indicated that happiness had a general facilitative effect on recall, whereas anger and sadness were associated with enhanced recall of information concerning goals and outcomes respectively. Findings indicate that specific emotions differ in their effects on memory and that negative emotions may facilitate selective encoding of functional information.

Emotion and episodic memory.

Allen, Philip A., et. al.

Handbook of episodic **memory**. Dere, Ekrem, (Ed); Easton, Alexander, (Ed); Nadel, Lynn, (Ed); Huston, Joseph P., (Ed); pp. 115-132; Amsterdam, Netherlands: Elsevier; 2008. xiii, 615 pp.

Abstract:

In the present chapter, we propose that emotion is an important contextual cue (or marker) for episodic memory. In past research and theory, temporal and spatial contexts have been discussed, but emotional context has been largely omitted from the literature on episodic memory. Based on the neural circuitry of incoming sensory information in the brain, we provide evidence that cognition is either moderated or mediated by basic affective processing. We review the evidence for a neural model in which the amygdala (affective processing—particularly negative emotions such as fear and anger), the ventromedial prefrontal cortex (emotional decision-making), and the dorsolateral prefrontal cortex (executive control and selective attention) are all involved in encoding and retrieval of episodic memory information. This view is largely based on an embellished version of Damasio and Bechara's somatic marker hypothesis with an evolutionary, survival emphasis. Finally, the research reviewed on episodic memory (mood induction, mood congruence, major depression, and the emotional mediation of age differences in episodic memory) is largely consistent with this view that emotions serve as contextual cues for episodic memories.