This Week in The Journal

How the Circadian Rise in Cortisol Affects Reconsolidation

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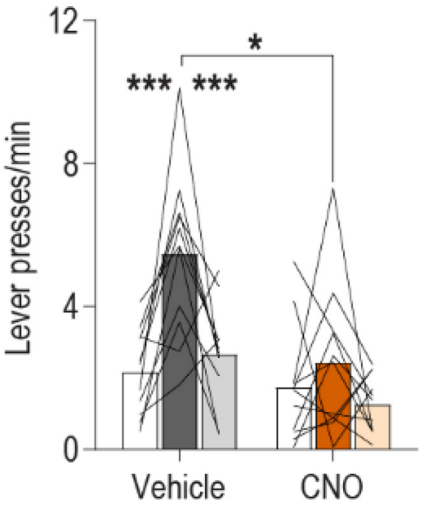
(see pages 7259–7266)

Newly encoded memories are strengthened and stabilized for long-term retention through a process called consolidation. Consolidated memories are not immutable, however. Each time a memory is recalled, it is destabilized, allowing it to be modified by new information. The original memory along with any modifications must then be reconsolidated to prevent weakening or loss.

Several factors contribute to the success of consolidation and reconsolidation. Consolidation occurs predominantly during slow-wave sleep, and sleep may promote reconsolidation as well. In addition, both consolidation and reconsolidation are influenced by stress; they can be either facilitated or impaired depending on the intensity of the stressor and its relevance to the remembered experience. Notably, cortisol, a hormone that mediates some of the effects of stress, is also under circadian control. In humans, cortisol levels decrease in the evening and begin ramping up around 4:00 A.M., peaking as we wake up. Therefore, consolidation and reconsolidation may be influenced by both sleep patterns and rising cortisol levels in the early morning hours.

To assess whether the morning rise in cortisol affects reconsolidation, Antypa et al. woke volunteers just before 4:00 A.M. and reactivated the memory of one of two stories that had been presented 3 d earlier. They then administered a cortisol synthesis inhibitor or placebo and allowed participants to return to sleep. After 4 more days, they tested participants' memories of both the reactivated and the not-reactivated story. When people received the placebo, recall was similar for the reactivated and the not-reactivated story. When people received the cortisol synthesis inhibitor, they recalled the not-reactivated story as well as people who received the placebo. But recall of the reactivated story was significantly greater after cortisol synthesis inhibitor was administered than after placebo administration.

These results suggest that any impairment in reconsolidation caused by the morning rise in cortisol may be offset by some other effect, such as rehearsal of the reactivated story before falling back to sleep. Consequently, memory enhancement was seen only when the cortisol rise was suppressed. This may be good news for people who ruminate on unpleasant experiences in the wee hours of the morning: the subsequent rise in cortisol may prevent overstrengthening of these memories.



When control (vehicle treated) rats hear a sound previously linked to a specific reward, they press a lever that delivers the same reward (dark gray bar) more often than they press it at baseline (white bar) or after hearing a cue signaling a different reward (light gray bar). When mOFC projections to the BLA are inhibited (CNO), however, lever pressing is not altered by cues. See Lichtenberg et al. for details.

Medial OFC–Amygdala Interactions in Cue-Guided Action

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(see pages 7267–7277)

Imagine you're feeling drowsy and your colleague tells you there's a fresh pot of coffee. This might prompt you to go to the break room and get a cup. But if you already had your fill of coffee, you might wait till you have a chance to get a cola. According to work by Lichtenberg et al., deciding what to do might involve communication between your basolateral amygdala (BLA) and medial orbitofrontal cortex (mOFC), especially if you're a rat.

Lichtenberg et al. trained rats to associate two sounds with different rewards. In separate training, the rats were taught that each reward could be obtained by pressing a different lever. After such training, presentation of either sound prompted rats to press the lever that delivered the reward signaled by that sound. Inhibiting activity of mOFC projections to the BLA diminished this effect: although rats pressed levers and approached the reward delivery port as often as controls, the auditory cues did not influence which lever they pressed. In contrast, inactivating projections from BLA to mOFC had no effect on the use of cues to guide lever pressing.

When a rat is given free access to a reward, the reward's value diminishes. Consequently, rats are less likely to respond to cues signaling the availability of that reward and are less likely to press a lever to obtain the reward; they continue to seek valued rewards, however. Lichtenberg et al. found that when mOFC projections to BLA were inactivated, rats showed the normal reduction in lever pressing for devalued rewards, but they continued to approach the reward port when the cue associated with the devalued reward was presented. Inactivating BLA projections to mOFC had similar effects: rats pressed the lever associated with the devalued reward less often, but they continued to approach the reward site in response to the cue associated with the devalued reward.

Together, these results indicate that the transmission of information from mOFC to BLA is required for rats to use information about reward availability to choose actions necessary to obtain specific rewards. In addition, they show that bidirectional communication between mOFC and BLA is required for the current reward value to influence cue-guided behaviors.

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