# During intense or emotionally arousing moments how does the brain know what to encode?

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Many of our most vivid memories arise from emotionally intense moments. But such memories also often have notable gaps and it can be hard to predict where the gaps will be. For instance, when seeing something emotionally intense—such as someone being shot—people will often have amnesia for what happened right beforehand. Likewise, emotionally evocative objects such as a gun usually impair memory for neutral background information. But sometimes emotionally intense events strengthen memories of neutral things that happened right beforehand or were in the background. What determines whether arousal will enhance or impair memory for a particular item or piece of information?

In a series of studies, we found that arousal enhances encoding high priority information while impairing encoding low priority information. Thus, arousal makes attention and memory more selective by favoring strong and inhibiting weak representations. This makes sense—during such moments it is especially important to focus on what matters most—but also raises questions about how this works in the brain. How can arousal have opposite effects on different memory representations depending on their priority? What is the neural marker of priority?

It has long been known that norepinephrine released by the locus coeruleus plays a key role in enhancing elements of emotionally arousing events. But how does this happen selectively and not to everything that was perceived at the moment of high arousal? In our Glutamate Amplifies Noradrengic Effects (GANE) model, we posit that there is local cortical control over norepinephrine release during arousing events through glutamatergic signaling. Glutamate is the brain's primary excitatory neurotransmitter. While a neural representation is highly active, glutamate is released in the synapses involved in that representation. Some of this synaptic glutamate spills over and can activate receptors on locus coeruleus axons passing through that local region. These glutamate sensitive receptors only activate when they both sense glutamate and the locus coeruleus neuron is itself depolarized or activated. When activated, the receptors stimulate more norepinephrine release at that local site. Thus, when there are high levels of local excitation at the same time as a burst of arousal, hot spots of high norepinephrine can further amplify glutamatergic activity. In contrast, locus coeruleus activity tends to inhibit glutamatergic activity in regions of cortex with low levels of excitation.

Thus, via this GANE mechanism, the brain can flexibly mark what has high priority at any particular moment, allowing arousal to highlight what really matters and suppress other potentially distracting information.