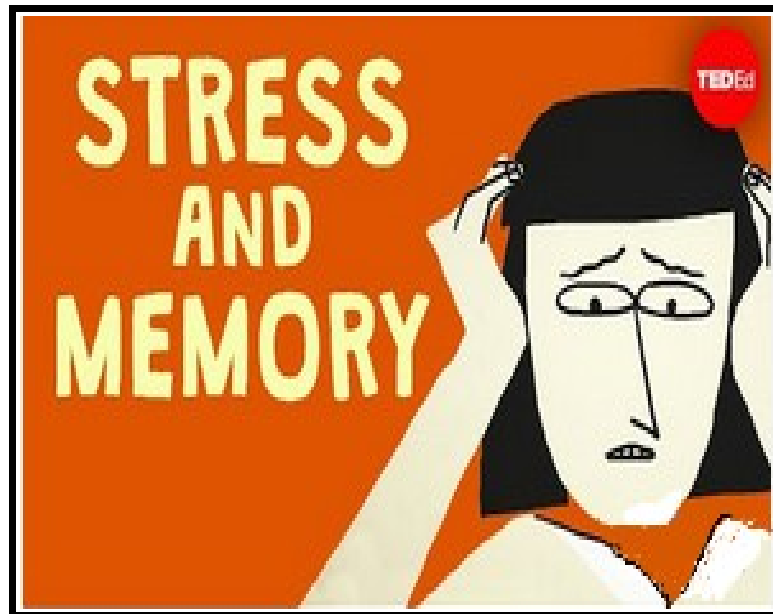


# The Surprising Link Between Stress and Memory



You spend weeks studying for an important test. On the big day, you wait nervously as your teacher hands it out. You're working your way through, when you're asked to define '**ataraxia**.' You know you've seen it before, but your mind goes blank. What just happened? The answer lies in the complex relationship between stress and memory. There are many types and degrees of stress and different kinds of memory, but we're going to focus on how short-term stress impacts your memory for facts.

To start, it helps to understand how this kind of memory works. Facts you read, hear, or study become memories through a process with three main steps. First comes acquisition: the moment you encounter a new piece of information. Each sensory experience activates a unique set of brain areas. In order to become lasting memories, these sensory experiences have to be consolidated by the hippocampus, influenced by the amygdala, which emphasizes experiences associated with

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strong emotions. The hippocampus then encodes memories, probably by strengthening the synaptic connections stimulated during the original sensory experience. Once a memory has been encoded, it can be remembered, or retrieved, later. Memories are stored all over the brain, and it's likely the prefrontal cortex that signals for their retrieval.

So how does stress affect each of these stages? In the first two stages, moderate stress can actually help experiences enter your memory. Your brain responds to stressful stimuli by releasing hormones known as corticosteroids, which activate a process of threat-detection and threat-response in the amygdala. The amygdala prompts your hippocampus to consolidate the stress-inducing experience into a memory. Meanwhile, the flood of corticosteroids from stress stimulates your hippocampus, also prompting memory consolidation. But even though some stress can be helpful, extreme and chronic stress can have the opposite effect. Researchers have tested this by injecting rats directly with stress hormones. As they gradually increased the dose of corticosteroids, the rats' performance on memory tests increased at first, but dropped off at higher doses. In humans, we see a similar positive effect with moderate stress. But that only appears when the stress is related to the memory task — so while time pressure might help you memorize a list, having a friend scare you will not. And the weeks, months, or even years of sustained corticosteroids that result from chronic stress can damage the hippocampus and decrease your ability to form new memories. It would be nice if some stress also helped us remember facts, but unfortunately, the opposite is true. The act of remembering relies on the prefrontal cortex, which governs thought, attention, and reasoning. When corticosteroids stimulate the amygdala, the amygdala inhibits, or lessens the activity of the prefrontal cortex. The reason for this inhibition is so the fight/flight/freeze response can overrule slower, more reasoned thought in a dangerous situation. But that can also have the unfortunate effect of making your mind go blank during a test. And then the act of trying to remember can itself be a stressor, leading to a vicious cycle of more corticosteroid release and an

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even smaller chance of remembering.

So what can you do to turn stress to your advantage and stay calm and collected when it matters the most? First, if you know a stressful situation like a test is coming, try preparing in conditions similar to the stressful environment. Novelty can be a stressor. Completing practice questions under time pressure, or seated at a desk rather than on a couch, can make your stress response to these circumstances less sensitive during the test itself. Exercise is another useful tool. Increasing your heart and breathing rate is linked to chemical changes in your brain that help reduce anxiety and increase your sense of well-being. Regular exercise is also widely thought to improve sleeping patterns, which comes in handy the night before a test. And on the actual test day, try taking deep breaths to counteract your body's flight/fight/freeze response. Deep breathing exercises have shown measurable reduction in test anxiety in groups ranging from third graders to nursing students.

So the next time you find your mind going blank at a critical moment, take a few deep breaths until you remember ataraxia: a state of calmness, free from anxiety.