

Practice testing protects memory against stress

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Learning by taking practice tests, a strategy known as retrieval practice, can protect memory against the negative effects of stress. Credit: Tufts University/Kevin Jiang

Learning by taking practice tests, a strategy known as retrieval practice, can protect memory against the negative effects of stress, report scientists from Tufts University in a new study published in *Science* on Nov. 25.

In experiments involving 120 student [participants](#), individuals who learned a series of words and images by [retrieval practice](#) showed no impairment in memory after experiencing [acute stress](#). Participants who used study practice, the conventional method of re-reading material to memorize it, remembered fewer items overall, particularly after stress.

"Typically, people under stress are less effective at retrieving information from memory. We now show for the first time that the right learning strategy, in this case retrieval practice or taking practice tests, results in such strong memory representations that even under high levels of stress, subjects are still able to access their memories," said senior study author Ayanna Thomas, Ph.D., associate professor and director of the graduate program in psychology

at Tufts.

"Our results suggest that it is not necessarily a matter of how much or how long someone studies, but how they study," said Amy Smith, graduate student in psychology at Tufts and corresponding author on the study.

The research team asked participants to learn a set of 30 words and 30 images. These were introduced through a computer program, which displayed one item at a time for a few seconds each. To simulate note taking, participants were given 10 seconds to type a sentence using the item immediately after seeing it.

One group of participants then studied using retrieval practice, and took timed practice tests in which they freely recalled as many items as they could remember. The other group used study practice. For these participants, items were re-displayed on the computer screen, one at a time, for a few seconds each. Participants were given multiple timed periods to study.

After a 24-hour break, half of each group was placed into a stress-inducing scenario. These participants were required to give an unexpected, impromptu speech and solve math problems in front of two judges, three peers and a video camera. Participants took two memory tests, in which they recalled the words or images they studied the previous day. These tests were taken during the stress scenario and twenty minutes after, to examine memory under immediate and delayed stress responses. The remaining study participants took their memory tests during and after a time-matched, non-stressful task.

Stressed individuals who learned through retrieval practice remembered an average of around 11 items out of each set of 30 words and images, compared to 10 items for their non-stressed counterparts. Participants who learned through

study practice remembered fewer words overall, with an average of 7 items for stressed individuals and an average of a little under 9 items for those who were not stressed.



To induce stress, study participants were required to give an unexpected, impromptu speech and solve math problems in front of two judges, three peers and a video camera. Credit: Tufts University/Kevin Jiang

"Even though previous research has shown that retrieval practice is one of the best learning strategies available, we were still surprised at how effective it was for individuals under stress. It was as if stress had no effect on their memory," Smith said. "Learning by taking tests and being forced to retrieve information over and over has a strong effect on long-term memory retention, and appears to continue to have great benefits in high-stakes, stressful situations."

While a robust body of evidence has previously shown that stress impairs memory, few studies have examined whether this relationship can be affected by different learning strategies. The current results now suggest that learning information in an effective manner, such as through retrieval practice, can protect memory against the adverse effects of stress.

Although the research team used an experimentally verified stress-inducing scenario (Trier Social Stress Test) and measured participant stress responses through heart-rate monitors and standardized self-reported questionnaires, they

note that stress effects are variable between individuals and additional work is needed to expand on their results. The team is now engaged in studies to replicate and extend their findings, including whether retrieval practice can benefit complex situations such as learning a foreign language or stressful scenarios outside of a testing environment.

"Our one study is certainly not the final say on how retrieval practice influences [memory](#) under [stress](#), but I can see this being applicable to any individual who has to retrieve complex information under high stakes," Thomas said. "Especially for educators, where big exams can put a great deal of pressure on students, I really encourage employing more frequent more low-stakes testing in context of their instruction."

More information: "Retrieval practice protects memory against acute stress." *Science* (2016). DOI: [10.1126/science.aah5067](https://doi.org/10.1126/science.aah5067).

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