Medical Xpress

Take note, students: Mice that 'cram' for exams remember less

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It's been more than 100 years since German psychologist Hermann Ebbinghaus determined that learning interspersed with rest created longer-lasting memories than cramming, or learning without rest.

Yet it's only much more recently that scientists have begun to understand the underlying molecular mechanisms for this phenomenon. In a study published Monday in the journal *PNAS*, researchers examined the physical changes in the brain cells of mice while "training" their eyes to keep track of a moving image.

Researchers examined the horizontal optokinetic response, or HOKR, in mice to determine what rest interval was best suited to increasing their memory.

HOKR is what makes it possible for a rider in a train to visually track the moving scenery. While the process is unconscious, it involves frequent, minute eye movements.

Mice were fastened to a device that immobilized their heads and then were made to look at a revolving, checkered image that triggered the eye response. A high speed camera was used to determine when the tracking began and when it stopped.

While the eyes of lab mice are initially unable to track the revolving image at a high speed, they eventually adapt to faster and faster movement. This tracking ability is retained for a period of time before it is forgotten.

Some of the mice were allowed to rest between training sessions, while others were not. Researchers noted clear differences between the mice that were given rest time "spacing" and those that received no breaks, or "massed training."

"One hour of spacing produced the highest memory retention at 24 hours, which lasted for one month," wrote lead study author Wajeeha Aziz, a molecular physiologist at the National Institute for Physiological Sciences in Okazaki, Japan, and her colleagues.

"Surprisingly, massed training also produced long-term memory. ... However, this occurred slowly over days, and the memory lasted for only one week."

Researchers compared brain tissue from the two groups of trained mice and with those of mice that received no training. They found that both groups of trained mice had reduced synapses in a specific type of nerve cell, Purkinje neurons.

However, spacing the training appeared to make these structural changes in synapses occur more quickly, the authors said.

"Further investigations are needed to elucidate the precise molecular mechanisms that regulate the temporal features of long-lasting memory, and the structural modifications of synapses provides an indispensable readout for such studies," the authors concluded.

More information: Distinct kinetics of synaptic structural plasticity, memory formation, and memory decay in massed and spaced learning, www.pnas.org/cgi/doi/10.1073/pnas.1303317110