

# Two-dimensional learning: Viewing computer images causes long-term changes in nerve cell connections

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Viewing two-dimensional images of the environment, as they occur in computer games, leads to sustained changes in the strength of nerve cell connections in the brain. In *Cerebral Cortex*, Prof. Dr. Denise Manahan-Vaughan and Anne Kemp of the RUB Department for Neurophysiology report about these findings. When the researchers presented rats with new spatial environments on a computer screen, they observed long-lasting changes in the communication between nerve cells in a brain structure which is important for long-term memory (hippocampus). Thus, the researchers showed for the first time that active exploration of the environment is not necessary to obtain this effect.

"These results help to understand to what extent digital learning in the brain competes with learning in the [physical environment](#)", says Manahan-Vaughan. "This is interesting for developing strategies for use of digital media in school. Such strategies can prove a useful antidote to the apathy in children towards the traditional teaching methods."

## Two mechanisms for learning in the brain

In the hippocampus, two different mechanisms for the long-term storage of new information are at work . Long-term potentiation leads to an increase in the communication between [nerve cells](#). Long-term depression, on the other hand, weakens the connections between the cells. "According to our results, [cell populations](#) react with potentiation

at the beginning, for instance when we enter a new room ", explains Manahan-Vaughan. "Long-term depression then allows us to refine this new cellular information and encode the details and characteristics of the room."

## Learning without movement

The Bochum team showed that long-term depression takes place in a special part of the hippocampus, when rats actively explore their environment. "We were, however, not sure if these changes in [nerve cell communication](#) were influenced by the movement of the animals or were purely due to learning about the novel objects", explains Manahan-Vaughan. In order to separate both effects, the researchers presented the spatial context via a computer screen so that active exploration of the environment was unnecessary. Long-term depression occurred also without movement, meaning that it mediates passive learning in the hippocampus.

## Computer and TV compete with learning in school

"School teachers, particularly at the junior school level have become increasingly concerned at their observations that each generation of school children exhibits shorter attention spans and poorer retention abilities than the previous generation", states Manahan-Vaughan. "One explanation for this is the ever increasing use of the digital media by school children. Our results indeed show that mammals can learn equally well when they passively view information on a computer screen compared to actively exploring the environment for this information. Television or computer games after school may compete with the information learned in school."

**More information:** A. Kemp, D. Manahan-Vaughan (2011). Passive

Spatial Perception Facilitates the Expression of Persistent Hippocampal Long-Term Depression, *Cerebral Cortex*, [doi:10.1093/cercor/bhr233](https://doi.org/10.1093/cercor/bhr233)

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