Scientists report giving flies false memories

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Biologists say they have given flies memories of a bad experience they never had, by manipulating the activity of individual brain cells.

The findings may shed light on how learning and memories work in more complex organisms also, the scientists claim.

“We like to take seemingly lofty psychological phenomena and reduce them to mechanics, to see for example how the intelligence needed to adapt to a changing environment can be reduced to physical interactions between cells and molecules,” said Gero Miesenböck of the University of Oxford, a member of the research group.

“The question is: how do you get intelligence from parts that are unintelligent?”

The findings are described in the Oct. 16 issue of the research journal *Cell*.

The background to the study was that “flies have the ability to learn, but the circuits that instruct memory formation were unknown,” Miesenböck said.

“We were able to pin the essential component down to 12 cells.” Those cells are sufficient to let the insect learn to associate a particular odor with something bad, like an electric shock, he explained. The cells essentially create memories that the fly then uses to avoid that odor.

To pinpoint the cells responsible for this memory among thousands of cells in the fly brain, the researchers used a technique in which a flash of light is used to release specific molecules from chemical “cages” inside certain cells. The molecules then stimulate an activity in those cells.

An analogous situation, said Miesenböck, is that if you wanted to send a message only to certain inhabitants of a city, you would give those you wanted to reach a radio tuned to the right frequency and send the message publicly, over the airwaves.

Miesenböck said his team made some educated guesses about the parts of the brain that would be important for the flies’ learning task. From there, they were able to narrow it down through experimentation to the 12-neuron brain circuit.

Remarkably, stimulating just these neurons gives the flies a memory of an unpleasant event that never occurred, he added.

Using their approach to “write directly to memory,” scientists can now obtain a level of evidence about brain function that was impossible before, Miesenböck said. He notes that neuroscience for a long time depended primarily on recording brain activity and attempting to correlate it to perceptions, actions, and cognition. But “it’s more powerful to seize control of the relevant brain circuits and produce these states directly,” he said.

Miesenböck adds that the simple brain of a fly likely can tell us much about how more complex brains work. “As a general rule, biology tends to be conservative,” he said. “It’s rare that evolution ‘invents’ the same process several times.” And, he said, even simple organisms may turn out to have a “surprisingly rich mental life.”