Snails on methamphetamine

May 28 2010

Lymnaea stagnails. Image: Wikipedia.

Crystal meth (methamphetamine) is a highly addictive drug that seduces victims by increasing self-esteem and sexual pleasure, and inducing euphoria. But once hooked, addicts find the habit hard to break. Barbara Sorg from Washington State University, USA, explains that amphetamines enhance memory. 'In addiction we talk about the "drug memory" as a "pathological memory". It is so potent as to not be easily forgotten,' she explains. As memory plays an important role in addiction, Sorg wondered whether it might be possible to find out more about the effects of meth on memory by looking at the effect it has on a humble mollusc: the pond snail *Lymnaea stagnalis*.

Lymnaea hold memories about when to breathe through their breathing tubes (pneumostomes) in a three neuron network, which is much simpler

than the colossal circuits that hold our memories. Ken Lukowiak from University of Calgary, Canada, has been working on the mechanisms of memory formation in these snails for most of his career, so he and Sorg decided to team up to find out whether a dose of meth could improve the snails' memories in the way it does human memories. They publish their discovery that memories formed by snails under the influence of meth are harder to forget, which could help us to understand human addiction, on 28 May 2010 in The Journal of Experimental Biology.

First Sorg and her students had to discover whether a dose of meth could affect the snails' breathing behaviour. According to Lukowiak, the snails breathe through their skins when oxygen levels are high, but when oxygen levels drop the snails extend their pneumostomes above the water's surface to supplement the supply. As the drug easily crosses the snail's skin, the team immersed the snails in de-oxygenated pond water spiked with meth, and watched to see how it affected their breathing. The snails stopped raising their pnemostomes at 1 and 3.3·μmol·l-1 meth, so having found a dose that altered the snail's behaviour, the team began testing its effects on the mollusc's long term memory.

The team trained the snails to remember to keep their pneumostomes closed when oxygen levels were low by poking them with a stick every time they tried to open their pneumostomes. Giving the snails two training sessions separated by an hour, the team knew that the molluscs would hold the memory for over 24·h, but what would happen if they trained the snails in meth-laced water?

Testing the snails in de-oxygenated pond water 24 hours later, the team were surprised to see that the snails seemed to have no recollection of their training, popping their pneumostomes above the water's surface. Maybe meth did not affect the snails' memories. But then Lukowiak remembered: 'If you put snails in a novel context even though they have memory they respond as if they don't have memory,' he says. Without

meth in the water, the snails were ignoring their memory. However, when the team reintroduced meth to the test water, the snails suddenly remembered to keep their pneumostomes closed. This could explain why it's so hard for human addicts to kick the habit when returning to old haunts that trigger the addiction memory.

Next the team wondered whether meth could improve the snails' memories. First they immersed the snails in meth-laced pond water, then they moved them into regular de-oxygented pond water and gave them a training session that the snails should only recall for a few hours. In theory the snails should have forgotten their training 24 hours later, but would the meth improve the snails' memories so they remembered to keep their pneomostomes closed a day later? It did. A dose of meth prior to training had improved the snails' memories, allowing them to recall a lesson that they should have already forgotten. And when the team tested whether they could mask the meth memory with another memory, they found that the meth memory was much stronger and harder to mask.

So memories formed under the influence of meth seem to be harder to forget, possibly because the drug disrupts the mechanisms for forgetting, and could help us to understand how amphetamines enhance memory in humans.

More information: Kennedy, C. D., Houmes, S. W., Wyrick, K. L., Kammerzell, S. M., Lukowiak, K. and Sorg, B. A. (2010). Methamphetamine enhances memory of operantly conditioned respiratory behavior in the snail Lymnaea stagnalis. J. Exp. Biol. 213, 2055-2065. http://jeb.biologists.org

Provided by The Company of Biologists

Citation: Snails on methamphetamine (2010, May 28) retrieved 20 April 2024 from https://phys.org/news/2010-05-snails-methamphetamine.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.