Sociable crayfish get drunk more easily than loners

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Cambaridae: Procambarus alleni. Credit: Thomas Seip/Wikipedia

Few studies have investigated how prior social experience affects

sensitivity to alcohol, but now a study from the University of Maryland shows that sociable crayfish are more sensitive than loners and suggests that similar mechanisms could make humans less sensitive to alcohol, leading them to consume more.

The effects of alcohol can be unpredictable; while some consumers become amiable and affectionate, others turn into brutish thugs, and Jens Herberholz, from the University of Maryland, explains that the cellular mechanisms that underpin the consequences of intoxication remain elusive. "Alcohol is a complicated drug", he says, because it affects a wide range of cellular systems, making it difficult to unravel which factors contribute to alcohol sensitivity. However, humans are not the only animals that can suffer the consequences of over-indulgence; inebriated crayfish tail-flip animatedly while under the influence and become heavily intoxicated after lengthy exposures. Having studied the cellular mechanisms that underlie decision-making and aggression in these crustaceans, Herberholz was curious to learn how previous social experience might impact the effect of alcohol on crayfish. Herberholz and students Matthew Swierzbinski and Andrew Lazarchik discovered that isolated crayfish are less sensitive to the effects of alcohol than gregarious animals and they publish their discovery in *Journal of Experimental Biology*.

"How past social experience might shape the neurobehavioural effects of acute alcohol exposure is significantly understudied", says Herberholz, who initially teamed up with Swierzbinski and Lazarchik to find out how inebriated crayfish behave. Intoxicating individual crayfish - which had previously been housed together - in tanks of dilute alcohol ranging from 0.1 to 1 mol/L, members of the lab filmed the animals as they initially began walking aggressively on stiff straight legs, before switching to tail-flipping as they became more intoxicated, and finally losing control as they rolled on their backs like incapacitated humans. And the effects took hold much faster at the highest concentrations, with the intoxicated

animals enthusiastically tail-flipping after 20 min in the strongest alcohol, while the animals that were bathed in the most dilute alcohol took almost 2 h to feel the effects. However, when the trio tested the effects of the most concentrated alcohol on crayfish that had been held in isolation for a week before their drinking spree, the animals were far less sensitive to the alcohol, taking 28 min to become inebriated and begin tail-flipping.

But how were the effects of intoxication manifested in the neurons that control the crayfish's drunken behaviour? Inserting fine silver wires near the sensory nerves that excite the lateral giant interneuron - which controls the tail-flipping behaviour - Lazarchik recorded that the neural circuit became more sensitive in both the isolated and gregarious crayfish when the crustaceans were inebriated. However, the effects of alcohol became apparent more swiftly in the sociable crayfish's lateral giant interneuron, mirroring the animals' behavioural sensitivity. Swierzbinski was even able to use intracellular electrodes to measure a difference in the effects of alcohol in individual neurons in the isolated and communal crayfish. Paying tribute to Swierzbinski, Herberholz says, "It takes talent and patience to collect data from enough animals".

As the inhibitions of the drunk socialised crayfish were loosened more than those of the drunken loners, Herberholz suspects that the alcohol has more of an impact on the GABA neurotransmitter, which inhibits behaviour, in the gregarious crayfish. He also speculates that isolation could make humans less sensitive to the effects of alcohol, leading them to consume more. Herberholz says, "Our study shows that social experience can change the sensitivity to acute alcohol". He adds, "Inebriated people...could potentially have different responses to alcohol depending on their prior social experience". And, although he emphasizes that we are still a long way from confirming that social experience produces similar effects in the brain circuits of inebriated mammals (including humans), Herberholz is optimistic that, one day,

drunken crayfish could help us to develop better treatments and preventative measures to support humans suffering from alcohol abuse.

More information: Swierzbinski, M. E., Lazarchik, A. R. and Herberholz, J. (2017). Prior social experience affects the behavioral and neural responses to acute alcohol in juvenile crayfish. *J. Exp. Biol.* 220, 1516-1523. DOI: 10.1242/jeb.154419