

# Frog embryos associate the smell of predators with danger

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A young wood frog. Credit: Michael Zahniser, via Wikimedia Commons.

(PhysOrg.com) -- A new study in the US and Canada has found that frogs can learn to associate the smell of predators with danger, even as embryos.

The aim of the experiments was to find out if woodfrog (*Rana sylvatica*) embryos could learn to associate the [odor](#) of injured tadpoles with that of their [predator](#), and if they could discriminate between different levels of threat. They also aimed to find out if the time of day would be a factor.

In the study, woodfrog egg masses were put into water containing the odor of tiger [salamanders](#) (*Ambystoma tigrinum*) and various

concentrations of "injured tadpole" odor between the hours of 1500 and 1700 for five consecutive days. They were then raised for nine days after hatching.

The scientists, Dr. Maud Ferarri, from the University of California at Davis, and Douglas Chivers from the University of Saskatchewan, created the olfactory cues by using water previously occupied by a tiger salamander, and water containing varying concentrations of crushed tadpoles. Both chemical cues were added to the water surrounding the frog egg masses.

When the eggs hatched, the scientists tested the responses of the tadpoles by placing them in fresh water and measuring how much they moved. They then added water containing the salamander odor, and measured their movements again. They checked the responses at different times. The results revealed that the embryos had learned to associate the predator's odor with danger.

The results ranged from tadpoles swimming normally to freezing for several minutes. Tadpoles that had been exposed as embryos to higher concentrations of injured tadpole odor froze for the longest time, which the scientists say shows they had learned to associate the salamander odor with danger. (Freezing is a common behavior when faced with a threat.) Responses were stronger between 1500 and 1700 hours than they were if the tadpoles were exposed to the odor either earlier or later.

The researchers said this type of learning has been found previously in larval amphibians, mosquitoes and fish, but had not been seen in embryos until now.

Dr. Ferarri said the [embryos](#) presumably "smell" the cues in the water surrounding the eggs. She also said that learning to detect predators at such an early stage makes evolutionary sense and there must be selection

for learning to detect predators in this way as it is often the only way they have to recognize them.

The findings of the study were published in the *Behavioral Ecology and Sociobiology* journal.

More information: The ghost of predation future: threat-sensitive and temporal assessment of risk by embryonic woodfrogs, *Behavioral Ecology and Sociobiology*, [DOI:10.1007/s00265-009-0870-y](https://doi.org/10.1007/s00265-009-0870-y)

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