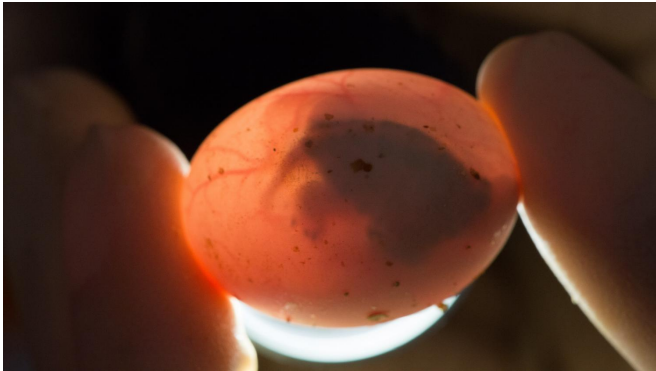


BPA can disrupt painted turtles' brain development could be a population health concern

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Cheryl Rosenfeld and her team found that BPA can induce behavioral changes in turtles, reprogramming male turtle brains to show behavior common in females. Researchers worry this could lead to population declines in painted turtles. Credit: Roger Meissen, Bond Life Sciences Center

Bisphenol A (BPA) is a chemical used in many consumer products including water bottles, metal food storage products and certain resins. Often, aquatic environments such as rivers and streams become reservoirs for BPA, affecting turtle habitats. Last year, a team of researchers led by the University of Missouri determined that BPA can disrupt sexual function in painted turtles, causing males to develop female sex organs. Now, the team has shown that BPA also can induce behavioral changes in turtles, reprogramming male turtle brains to show behavior common in females. Researchers worry this could lead to population declines in painted turtles.

"Previously, our research team found that BPA and ethinyl estradiol (EE2), a hormone found in birth control pills, could 'sex-reverse' turtles from males to females," said Cheryl Rosenfeld, an associate professor of biomedical sciences in the MU

College of Veterinary Medicine and an investigator in the Bond Life Sciences Center. "Painted turtles and other reptiles lack sex chromosomes. The gender of painted turtles and other reptiles is determined by the [incubation temperature](#) of the egg during development. Studies have shown that exposure to endocrine-disrupting chemicals (EDCs), such as BPA, can override incubation temperature and switch the sex of males to females. In our latest study, we found that BPA also affects how the male brain is 'wired,' potentially inducing males to show female type behavioral patterns."

Researchers applied a liquid form of BPA and ethinyl estradiol to painted turtle eggs and incubated the eggs at a temperature that typically results in males. Five months after hatching, turtles were tested with a spatial navigation test that included four food containers, only one of which was baited with food. Each turtle was randomly assigned one food container that did not change over the trial period.

Researchers predicted that male turtles exposed to BPA and EE2 would exhibit improved navigational ability—similar to behaviors observed in female turtles. Results showed that developmental exposure to BPA and EE2 improved spatial navigational learning and memory in males, as evidenced by increased number of times spent in the correct target zone and greater likelihood of solving the maze compared to control turtles, who were male based on the lower incubation temperature.

"Previous studies have found that female turtles are much more adept at spatial navigation—think of female sea turtles that return many years later to the same beaches where they hatched to lay their own eggs," Rosenfeld said. "We found that

developmental exposure to BPA essentially overrides the brain development of male turtles as indicated by the enhanced navigational ability of the turtles we studied. While improved spatial navigation might be considered a good thing, it also may suggest that when they reach adulthood male turtles will not exhibit courtship behaviors needed to attract a mate and reproduce, which could result in dramatic [population declines](#)."

Rosenfeld notes that this is the first study to show that these harmful chemicals not only reverse the physical sex-characteristics but also affect the brain in a turtle species. Turtles are known as an "indicator species" because they can be used as a barometer for the health of the entire ecosystem. By understanding the possible effects EDCs have on turtles, researchers might be able to understand the possible effects the chemicals have on other wildlife species and humans, Rosenfeld said.

"Effects of developmental exposure to bisphenol A and [ethinyl estradiol](#) on spatial navigational learning and memory in painted [turtles](#) (*Chrysemys picta*)," recently was published in the journal, *Hormones and Behavior*.

More information: Lindsey K. Manshach et al, Effects of developmental exposure to bisphenol A and ethinyl estradiol on spatial navigational learning and memory in painted turtles (*Chrysemys picta*), *Hormones and Behavior* (2016). [DOI: 10.1016/j.yhbeh.2016.07.009](#)

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