2018

Behavior and Personality in Heat-Shocked Lizard Hatchlings

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Introduction

Ectotherms are extremely sensitive to the temperature of their environments, due to their inability to physiologically regulate their body temperature. In fact, environmental conditions can affect ectotherms even *before* hatching, as incubation temperatures impact embryonic development in oviparous eggs. Specifically, increases in incubation temperature can significantly alter the morphology of the vertebrate face and brain.

While previous studies have explored the associations between these morphological changes and learning and cognition in lizards, no study to date has focused on how these heat-induced craniofacial changes are associated with lizard social and exploratory behavior. Behavior (how an individual responds to a particular situation) and personality (consistency in an individual's traits in different situations) represent an important aspect of ecology, as an individual's behavioral tendencies determine its likelihood to explore, find prey, and interact successfully with both predators and conspecifics. More broadly, behavior and personality play a role in fitness and help to determine which traits will be successful in a population.

In this study, we focus on the behavior—specifically the boldness and aggression—of brown anole lizard (*Anolis sagrei*) hatchlings incubated at normal (27°C, N = 7) and "hot" (34°C, N = 4) temperatures. Using a variety of behavioral trials including interaction with novel objects, prey type, environment, conspecifics, and predators, we seek to address the question of how warming climates may affect the personalities of *Anolis* lizards.

General Methods

1. Eggs were collected upon oviposition from wild-caught, brown anole females. Eggs were placed in petri dishes containing a 1:1 mix of vermiculite and water and incubated at 27°C or 34°C.
2. Upon hatching, brown anole hatchlings were housed individually or in groups of 2-3 in small, clear Kritter Keeper cages in a humidity (average 50%), temperature (average 27°C), and light-controlled incubation chamber. Hatchlings were fed daily and misted with water every 2-3 hours.
3. All behavioral trials were conducted on hatchlings 4-10 days post-hatching. All trials were conducted in a climate-controlled incubation chamber. Hatchlings were exposed to 2 trials per day, separated by at least 1 hour.

Discussion

Our data suggest that "hot" hatchlings are less exploratory and less aggressive than hatchlings incubated at normal temperatures. Hot hatchings tend to move less often and less quickly than the normal hatchlings, which could have significant implications for their ability to survive and interact with predators, prey, and conspecifics.

NSF Biology Summer Undergraduate Research Fellowship

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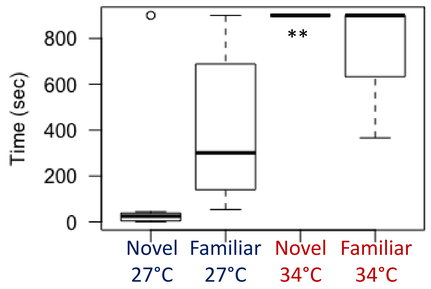
Behavioral Trials: Methods and Results

Prey Trial

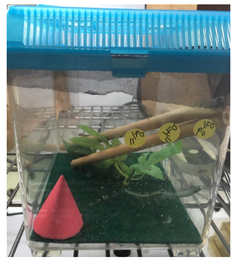
Methods: We performed prey trials for 4 consecutive days. During the first 3 days of trials, hatchlings were fed a familiar prey source (flightless fruit flies). On the fourth day of food trials, hatchlings were fed a novel food source (1/4 in mealworms). In each trial, we recorded the latency of each hatchling to consume the prey.

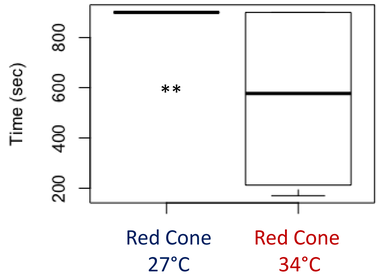


Results: We found that normal hatchlings consumed novel prey more quickly than "hot" hatchlings (U = 2.0, p = 0.017). Similarly, there was a trend suggesting faster consumption of familiar prey by 27°C hatchlings than 34°C hatchlings (U = 4.5, p = 0.066).

Novel Object Trial

Methods: We performed novel object trials for 3 consecutive days. On each day, we placed a novel object of a different size, color, and shape in the home cage of the hatchlings. We recorded the latency of each hatchling to approach each novel object.

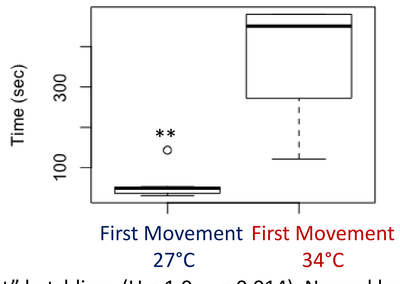




Results: There was no difference between the latencies of "hot" and normal hatchlings to approach the blue and yellow novel objects (both p > 0.14). However, "hot" hatchlings approached the red cone more quickly than normal hatchlings (U = 7.0, p = 0.050).

Open Field Test

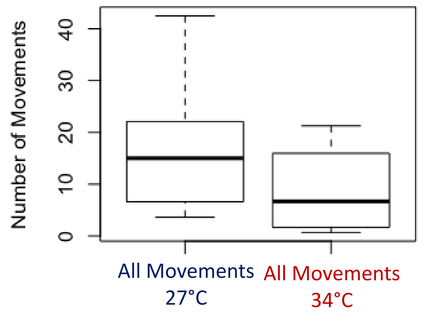
Methods: Hatchlings were placed in a mesh cage marked with 2"x2" gridlines. After acclimating under an opaque plastic planter for 8 min, the hatchling was allowed to explore the mesh cage during an 8 min trial. We recorded the hatchling's latency to first move, the number of movements, and the number of gridlines crossed.



Results: Normal hatchlings moved earlier than "hot" hatchlings (U = 1.0, p = 0.014). Normal hatchlings also crossed more lines (U = 2.0, p = 0.023), and performed marginally more movements (U = 4.5, p = 0.071).

Conspecific Trial

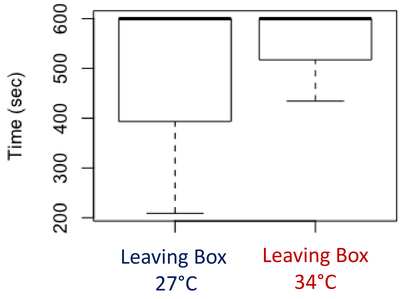
Methods: We matched each hatchling with familiar (housed in the same cage) and novel (housed in a different cage) hatchlings. In each trial, we placed both hatchlings in a small, clear Kritter Keeper containing one central perch, where they were allowed to acclimate under opaque plastic planters for 8 min. In an 8 min trial, we recorded all hatchling movements and displays. The hatchling who first climbed the central perch was considered to be the "winner" of the trial.



Results: There was no significant difference between the number of movements or displays of normal and "hot" hatchlings. However, no "hot" individual ever climbed on the central perch in a trial, meaning no clear winner was determined in "hot" hatchling conspecific trials (U = 2.0, p = 0.022).

Predator Trial

Methods: A small, clear Kritter Keeper containing an adult female anole was placed in the middle of a larger, clear Kritter Keeper. The larger Kritter Keeper contained a perch and a wooden box containing a hatchling. The hatchling was allowed to acclimate in the wooden box for 8 min, then a sliding door on the box was opened to reveal the predator directly in front of the hatchling. After 5 min of exposure to the predator, the door to the wooden box was closed and the predator was removed. After another 2 min interval, the door was reopened. The latency of the hatchling to leave the wooden box and the latency to reach the perch were recorded.



Results: No differences were found between the latency of normal and "hot" hatchlings to leave the wooden box, or to reach the perch following exposure to a predator (p > 0.5).