Study suggests natural selection could have influence on lizards' 'personalities'

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Anolis carolinensis. Credit: Robert Michniewicz, CC BY 3.0

For more than a century, scientists have understood that natural selection have profound effects on how an animal looks—Anolis lizards that

spend more time on the ground, for example, might need longer legs for running, while species that remain in the trees usually have shorter legs better suited for climbing.

But can different behaviors be favored by natural selection under different environments?

Scientists have long believed the answer was yes, but empirical data to support this idea was lacking, but a new paper authored by Oriol Lapiedra, a post-doctoral fellow working in the lab of former Harvard faculty members Jonathan Losos, have provided experimental evidence to support it.

Working with Losos, now the William H. Danforth Distinguished University Professor at Washington University at Saint Louis and Director of the Living Earth Collaborative, while both were still at Harvard, Lapiedra is the lead author of a recent study that demonstrated a link between individual variation in risk-taking behavior and survival of animals in changing environments.

Along with Lapiedra and Losos, researchers from the University of Rhode Island, UC at Davis and the University of Missouri also co-authored the study.

The first-of-its-kind study released small populations of lizards onto tiny, uninhabited islands in the Bahamas, and found that specific personality types—the very bold or the very shy—survived longer depending on whether predators were present. The study was described in a paper published earlier this year in *Science*.

"As biologists, when we describe animals, we have the genetic part—what we call genotypes—and we have what we can see about the animal—what we call phenotypes," Lapiedra said. "Traditionally, when

we think of phenotypes, we focus on morphology and physiology, but another important dimension of phenotype is behavior. Because behavior actually determines how animals interact with their environment, we expected it to be an important factor for animals to survive new ecological challenges. For instance, one would expect that behavior will play a relevant role in determining the survival of animals in the current context of global climate change."

Surprisingly, however, no experimental studies had been able to actually conduct an experiment in wild animal populations and test the idea in nature.

To pull it off, Lapiedra got some help from tiny lizards called anoles that are native to islands throughout the Caribbean.

Widely studied by biologists, including Losos, the lizards prefer to perch on low vegetation, but must forage for food on the ground, which exposes them to other, predatory lizard species.

"As you can imagine, there's a tradeoff here," Lapiedra said. "They need to go to the ground to get food, but that's where the predators are. So you could make a prediction that, if ground predators aren't present, the animals that are more bold, or willing to take risks, might go to the ground more often. They would get more food, have more offspring and pass on their genes.

"But what happens when there are predators on the ground?" he continued. "Then you would expect the opposite to happen—the bold lizards would be killed more frequently. This is a very simple idea, but up until now, we didn't have evidence from nature that natural selection acted on individual variation in behavior."

To test it, Lapiedra identified a number of tiny—only a few hundred

square feet—islands in the Bahamas that had been scoured clean of lizards by recent hurricanes.

Lapiedra and colleagues trapped hundreds of lizards from the surrounding area and subjected each to a type of lizard "personality test" to evaluate their risk-taking behavior.

The lizards were placed in small experimental enclosures and researchers measured their willingness to explore their surroundings by tracking how long they waited before leaving their refuges. The team also tracked how much time each lizard spent on the ground before jumping to a perch. Based on those results, each lizard was assigned a score on a spectrum from very bold to very shy, and were implanted with unique "alpha tags," similar to those used to identify pets.

"What we did was to simulate the process of natural colonization on these islands," Lapiedra said. "On eight islands, we released lizards that ranged from very bold to very shy. On four of the islands, we went back one week later and also released native ground predators, namely curly tailed lizards, so what we have are two scenarios—on four islands, the lizards can get as much food as they want, and they don't need to worry about predators on the ground. On those islands we expected the lizards who were more willing to take risks to survive and produce more offspring.

"On the islands with predators, however, we expected that lizards with bolder 'personalities' would spend a lot of time on the ground, and would be more vulnerable to predation," he continued. "After a few months, when we went back to the islands, that's exactly what we found."

The authors of this study also found selection for different morphological traits that occurred in parallel to natural selection on behavior. This result is particularly exciting because it shows that natural

selection is a complex process that can simultaneously shape different phenotypic dimensions such as behavior and morphology at the same time.

Besides upending the common view that natural selection and evolution can drive physical, but not behavioral changes, the study points to the need for further research.

"Traditionally, people have assumed an animal might be bold or shy depending on the situation, but as we are doing more research in this field, we are realizing that is not the case," Lapiedra said. "Researchers are increasingly finding that there are individuals that are always shy or others that are always bold." Unraveling how these behavioral traits emerge and change through time will help us understand how animals deal with changes in their environments—an idea of major importance in our rapidly changing Planet.

And though the study demonstrated that those traits can face pressure from natural selection, it's not yet clear whether they can be inherited by later generations.

"Natural selection is crucial for adaptation to new environmental challenges," Lapiedra said. "But the presence of natural selection per se does not imply evolution. What we have shown is that there is consistent variation in behavior. If there is heritability in behavior...lizards that are more bold would have more bold offspring. But so far, we don't have evidence for this. We can say that some phenotypes survive better than others in certain conditions...but that does not necessarily imply evolution."

That evidence, however, may be on the way. Lapiedra and colleagues have been collecting genetic samples from the offspring born on the islands and are using genetic tools to identify whether they inherit their

bold or shy nature from their parents.

"We have two years of data already," he said. "From that we hope to be able to say if behavior is heritable or not, and if it's changing in one direction or not. So that would provide actual evidence for evolution in behavior—that would be a big step to unravel the role behavior plays in evolution."

More information: Oriol Lapiedra et al, Predator-driven natural selection on risk-taking behavior in anole lizards, *Science* (2018). DOI: 10.1126/science.aap9289

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