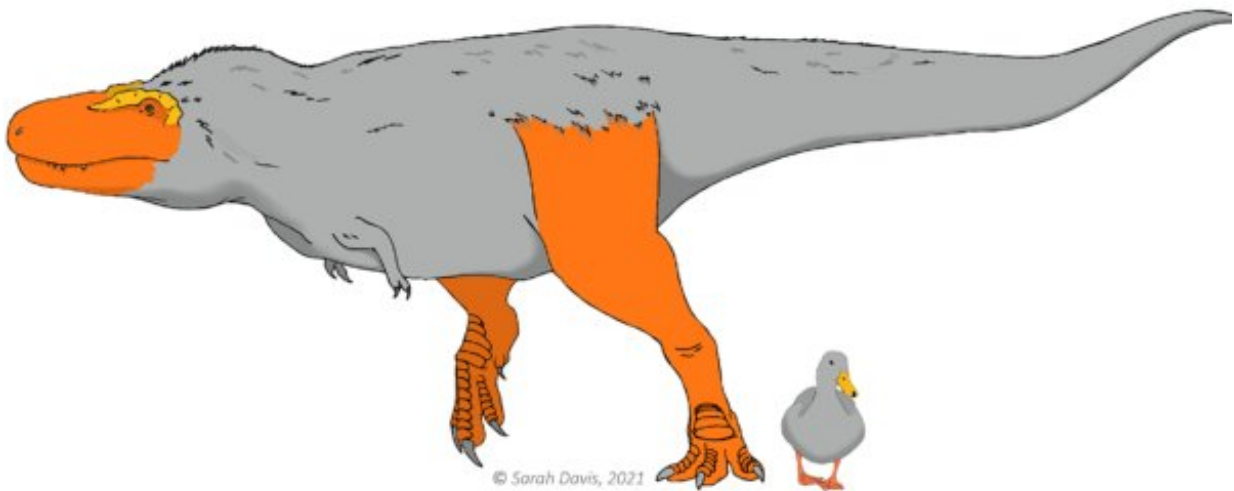


Dinosaur faces and feet may have popped with color

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Extinct dinosaurs may have had bright color on their skin, scales and beaks in a manner similar to modern birds. Credit: Sarah Davis

Most birds aren't as colorful as parrots or peacocks. But if you look beyond the feathers, bright colors on birds aren't hard to find: Think

pink pigeon feet, red rooster combs and yellow pelican pouches.

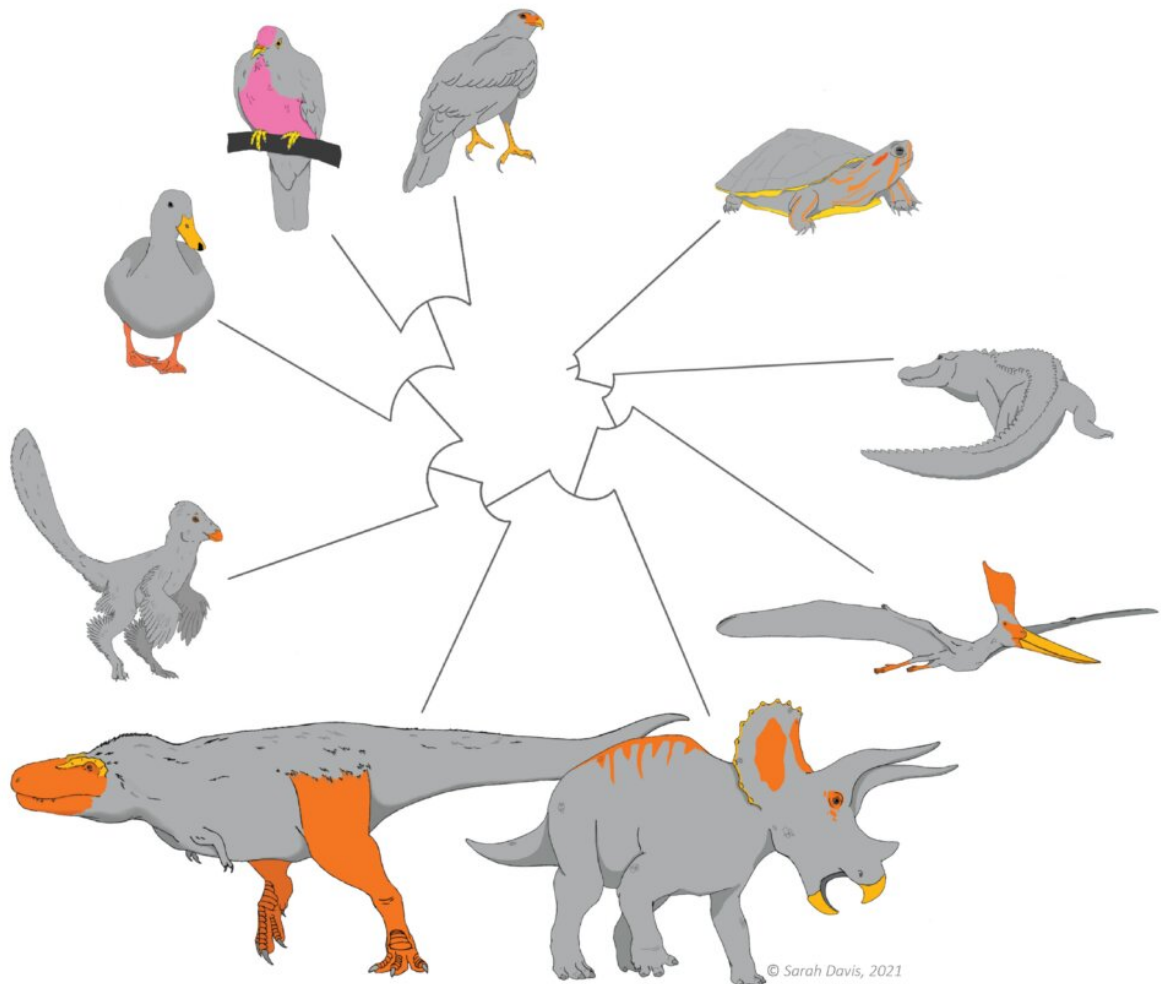
There's a good chance that extinct [dinosaurs](#) rocked pops of [color](#) on similar body parts and may have flashed their colors to entice mates, just as birds do today, according to a study led by researchers at The University of Texas at Austin.

"Living birds use an array of pigments and can be very colorful on their [beaks](#), legs, and around their eyes," said Sarah Davis, a doctoral candidate at the UT Jackson School of Geosciences who led the study. "We could expect that extinct dinosaurs expressed the same colors."

The research was published in the journal *Evolution* on Dec. 6.

The takeaway on potential dinosaur color schemes comes from broader findings about skin and tissue color in the common ancestor of living birds and extinct dinosaurs, an ancient archosaur that lived near the beginning of the Triassic period. By analyzing whether bright body color was present in living dinosaur relatives—including turtles, crocodiles and over 4,000 bird species—the researchers determined that the common ancestor had a 50% chance of having bright colors in the soft tissues of its body.

The bright colors examined in the study typically come from [carotenoids](#)—a class of colorful red, orange and yellow pigments that birds extract from their food. Carotenoids do not fossilize as well as brown and black pigments, which means scientists must study color in living animals to look for clues about color expression in their extinct ancestors.



Tissues that can express carotenoid colors:

■ Skin
 ■ Non-feather Keratin
 ■ Feathers

A simplified evolutionary tree showing where bright colors appear on birds and other living species from this study and where these colors may have appeared on their extinct relatives, including dinosaurs. Skin (shown in orange), and scales and beak keratin (yellow) could have been brightly pigmented in extinct groups, whereas feathers and claws would probably not have been. Areas without bright color are shown in gray. Credit: Sarah Davis / The University of Texas at Austin

The researchers used the data collected from birds and other animals to make phylogenetic reconstructions, a scientific method used to investigate the evolutionary histories of species. The 50% estimate for bright color applies equally to skin, beaks and [scales](#) of the ancient archosaur. In contrast, the research found that there was a 0% chance that claws and feathers were brightly colored, which is consistent with other research, Davis said.

The study also examined the connection between color and a [diet](#) high in carotenoids, with Davis finding that birds with higher carotenoid diets (plant- and invertebrate-rich) were more likely to be colorful than meat eaters. What's more, she found that plant-eating birds expressed bright colors in more places on their bodies than meat eaters or omnivores.

"The earliest dinosaurs were pony-sized and ate large, vertebrate prey," said study co-author Julia Clarke, a professor at the Jackson School. "Different groups shifted to plant-dominated or mixed diets. This shift likely led to changes in coloration of skin and non-feather tissues."

In addition to coloring the past, the research puts living birds in a new perspective. Davis said that the bird groups examined in the study have a reputation for being drab—especially in comparison to songbirds, which were excluded from the study because they are the most distantly related to their nonavian dinosaur ancestors.

But aside from their feathers, the birds turned out to be quite colorful. The study found that about 54% of the 4,022 bird species studied had bright colors. Of this group, 86% of species expressed bright color in only non-feathered tissues.

Mary Caswell Stoddard, an associate professor at Princeton University, said that the study provides important insights on bird color that often go overlooked.

"There is so much more to birds' color than their plumage—just think of the vibrant orange-yellow bill of a toco toucan—but feathers tend to get the most attention," she said. "This study unravels the evolutionary history of carotenoid-based coloration not just in plumage but also in the beaks and [skin](#) of [birds](#) and their relatives."

More information: Sarah N. Davis et al, Estimating the distribution of carotenoid coloration in skin and integumentary structures of birds and extinct dinosaurs, *Evolution* (2021). [DOI: 10.1111/evo.14393](https://doi.org/10.1111/evo.14393)

Provided by University of Texas at Austin

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