To avoid interbreeding, monkeys have undergone evolution in facial appearance

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Guenon monkeys have undergone a remarkable evolution in facial appearance as a way of avoiding interbreeding with closely related and geographically proximate species, researchers from NYU and the University of Exeter have

found. Shown here is one species of guenon: Cercopithecus erythrotis. Credit: William Allen / Nature Communications

Old World monkeys have undergone a remarkable evolution in facial appearance as a way of avoiding interbreeding with closely related and geographically proximate species, researchers from New York University and the University of Exeter have found. Their research provides the best evidence to date for the role of visual cues as a barrier to breeding across species.

"Evolution produces adaptations that help animals thrive in a particular environment, and over time these adaptations lead to the evolution of new species," explains James Higham, an assistant professor in NYU's Department of Anthropology and the senior author of the study, which appears in the journal *Nature Communications*. "A key question is what mechanisms keep closely related species that overlap geographically from inter-breeding, so that they are maintained as separate species.

"Our findings offer evidence for the use of visual signals to help ensure species recognition: species may evolve to look distinct specifically from the other species they are at risk of inter-breeding with. In other words, how you end up looking is a function of how those around you look. With the primates we studied, this has a purpose: to strengthen reproductive isolation between populations."

The study's lead author was William Allen, who undertook the work while a post-doctoral researcher in NYU's Department of Anthropology. The researchers studied guenons—a group of more than two dozen species of monkeys indigenous to the forests of Central and West Africa. Many different species of guenons are often sympatric—they live in close proximity to each other, with multiple species often

traveling, feeding, and sleeping side-by-side. Therefore interbreeding, which could result in afflicted infertile offspring, remains an unwelcome possibility.

In the 1980s, Oxford zoologist Jonathan Kingdon tried to explain the diversity in facial appearance of guenons, which show markings such as differently colored eyebrow patches, ear tufts, nose spots, and mouth patches. He hypothesized that sympatric guenon species had undergone facial changes that visually reinforced differences among their species in order to avoid the risks of hybridizing.

However, Kingdon's ideas were primarily based on observations with the naked eye, and he failed to find evidence for his hypotheses. The NYU and University of Exeter scientists sought to test Kingdon's conclusions quantitatively using sophisticated methods—facial recognition algorithms that can identify and quantify detailed features in faces.

To do this, they photographed nearly two dozen species of guenons in various settings, over an 18-month period: in zoos in the United States and the United Kingdom and in a wildlife sanctuary in Nigeria. Armed with more than 1,400 standardized photographs, the researchers employed what is known as the eigenface technique, which has been used in the field of computer vision for machine recognition of faces, in order to distinguish primate features and then to determine whether the appearance of each guenon species was related to the appearance of other species.

Their results showed that, as predicted, the face patterns of guenon species have evolved to become more visually distinctive—specifically from those guenon species they overlap with geographically—and hence those that they are risk of hybridizing with.

"These results strongly suggest that the extraordinary appearance of

these monkeys has been due to selection for visual signals that discourage hybridization," observes lead author Allen, now at the University of Hull. "This is perhaps the strongest evidence to date for a role for visual signals in the key evolutionary processes by which species are formed and maintained, and it is particularly exciting that we have found it in part of our own lineage."

Provided by New York University

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