Old-World Primates Evolved Color Vision to Better See Each Other Blush, Study Reveals

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Your emotions can easily be read by others when you blush--at least by others familiar with your skin color. What's more, the blood rushing out of your face when you're terrified is just as telling. And when it comes to our evolutionary cousins the chimpanzees, they not only can see color changes in each other's faces, but in each other's rumps as well.

Now, a team of California Institute of Technology researchers has published a paper suggesting that we primates evolved our particular brand of color vision so that we could subtly discriminate slight changes in skin tone due to blushing and blanching. The work may answer a long-standing question about why trichromat vision (that is, color via three cone receptors) evolved in the first place in primates.

"For a hundred years, we've thought that color vision was for finding the right fruit to eat when it was ripe," says Mark Changizi, a theoretical neurobiologist and postdoctoral researcher at Caltech. "But if you look at the variety of diets of all the primates having trichromat vision, the evidence is not overwhelming."

Reporting in the current issue of the journal Biology Letters, Changizi and his coauthors show that our color cones are optimized to be sensitive to subtle changes in skin tone due to varying amounts of oxygenated hemoglobin in the blood.

The spectral sensitivity of the color cones is somewhat odd, Changizi says. Bees, for example, have four color cones that are evenly spread

across the visible spectrum, with the high-frequency end extending into the ultraviolet. Birds have three color cones that are also evenly distributed in the visible spectrum.

The old-world primates, by contrast, have an "S" cone at about 440 nanometers (the wavelength of visible light roughly corresponding to blue light), an "M" cone sensitive at slightly less than 550 nanometers, and an "L" cone sensitive at slightly above 550 nanometers.

"This seems like a bad idea to have two cones so close together," Changizi says. "But it turns out that the closeness of the M and L cone sensitivities allows for an additional dimension of sensitivity to spectral modulation. Also, their spacing maximizes sensitivity for discriminating variations in blood oxygen saturation." As a result, a very slight lowering or rising of the oxygen in the blood is easily discriminated by any primate with this type of cone arrangement.

In fact, trichromat vision is sensitive not only for the perception of these subtle changes in color, but also for the perception of the absence or presence of blood. As a result, primates with trichromat vision are not only able to tell if a potential partner is having a rush of emotion due to the anticipation of mating, but also if an enemy's blood has drained out of his face due to fear.

"Also, ecologically, when you're more oxygenated, you're in better shape," Changizi adds, explaining that a naturally rosy complexion might be a positive thing for purposes of courtship.

Adding to the confidence of the hypothesis is the fact that the old-world trichromats tend to be bare-faced and bare-butted as well. "There's no sense in being able to see the slight color variations in skin if you can't see the skin," Changizi says. "And what we find is that the trichromats have bare spots on their faces, while the dichromats have furry faces."

"This could connect up with why we're the 'naked ape,'" he concludes. The few human spots that are not capable of signaling, because they are in secluded regions, tend to be hairy-such as the top of the head, the armpits, and the crotch. And when the groin occasionally does tend to exhibit bare skin, it occurs in circumstances in which a potential mate may be able to see that region.

"Our speculation is that the newly bare spots are for color signaling."

The other authors of the paper are Shinsuke Shimojo, a professor of biology at Caltech who specializes in psychophysics; and Qiong Zhang, an undergraduate at Caltech.

Source: Caltech