# Urine Vision? How Rodents Communicate With UV Light

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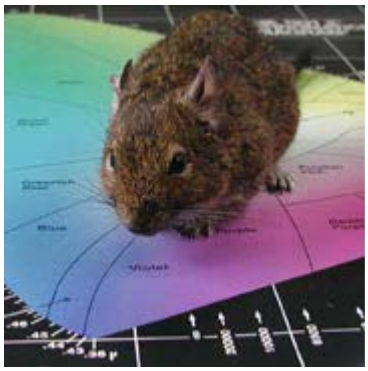

The degu (*Octodon degus*) is among the rodents that have the ability to see the ultraviolet spectrum.

*Photograph by Patricio Velez, University of Valparaiso*

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Many fish, reptiles, birds, and insects are able to see ultraviolet light. Some even use pigments that reflect it to attract mates and communicate. But most mammals have lost the ability to see ultraviolet light and lack the cellular machinery necessary to detect it.

Now, a new study suggests that urine plays such an important role on the rodent communication grapevine that it may explain why some species have retained ultraviolet (or UV) sensitive cells and visual pigments and other mammals haven't. The urine of many species of rodent strongly reflects ultraviolet light, says the study published in a recent edition of the journal *Investigative Ophthalmology and Visual Science*.

The ultraviolet messages left with urine could be dangerous, says the study. Other research has shown that UV-vision might be used by birds of prey to pinpoint the location of their next meal.

**Dinosaurs' Shadow**

Visual pigments are found in specialized retinal cells at the back of the eye. They react to different wavelengths of light, or colors, and allow humans to detect them. As mammals, we are totally ignorant to the ultraviolet hues that adorn both the plumage of brightly colored birds like blue tits, and attract bees

and butterflies to the petals of many common flowers. In fact most mammals have just half as many types of color-receptive cells as the eyes of many other vertebrates.

One theory is that tens of millions of years ago when dinosaurs filled the jobs of most of today's large mammals, small scavenging mammalian ancestors were forced to become entirely nocturnal, said neurobiologist Leo Peichl at the Max Planck Institute for Brain Research in Frankfurt Germany. In the night-time environment, both UV and color vision are functionally useless. Without a use for UV vision, mammals eventually lost the ability.

"Mammals had to cope with what they had after this, and for many this seemed sufficient," said Peichl.

Unique among mammals however, many rodents—such as rats, mice, and gerbils—have retained the ability to see UV light, though the reasons behind this have remained mysterious.

**Guinea Pig Relative**

To answer this question, scientists in Chile and Germany have been studying the color vision capabilities and environment of the South American degu (*Octodon degus*), a relative of the guinea pig.

Lead scientist Adrian Palacios at the University of Valparaiso in Chile, Peichl, and co-authors examined the cellular make-up of the degu retina. The retina is a layer at the back of the eye packed with light-detecting cells. Experiments revealed the same cells that have also been discovered in rats, gophers, gerbils, mice, and hamsters. The cells are sensitive to light in the ultraviolet part of the

spectrum.

A quick scan of the animal's natural environment revealed that food plants, soil, and stone all reflect ultraviolet light poorly. However several things did reflect ultraviolet light very well, and one of these was degu urine.

For many social animals that live in colonies, scent marking is an important process, helping the animals to follow commonly used paths through vegetation and reinforce the status of more senior animals. However, it's difficult to quickly localize the direction a scent is coming from, said Peichl, suggesting that ultraviolet visual cues might make it easier for animals to find their way quickly. Fresh urine also reflects more strongly than old. That could indicate how fresh a path is, what came past, when, and what sex the animal was.

The authors also noticed that the degu has white markings on its chest region, which are revealed when the animals raise up on their hind legs to make alarm calls warning of possible danger. These markings also reflect ultraviolet light, said Peichl.

The importance of communicating with urine could have favored the retention of UV- vision in the degu and other rodents, says the study.

**Harmful Light**

"It wasn't realized until fairly recently that rodents had ultraviolet vision," commented David Hunt a molecular geneticist at University College London's Institute of Ophthalmology in the United Kingdom.

Ultraviolet light damages the eye, in much the

same way ultraviolet rays from the sun are bad for the skin, said Hunt. This might explain why some species lack the ability to see it. Many mammals have filters in the lens of the eye, which block UV rays.

The importance of ultraviolet vision for communication with urine could explain why the degu has retained the ability to detect light at that wavelength, said Hunt. But more evidence would be required to claim that this explains ultraviolet vision in other rodents, he said.

Admittedly some of the rodents that possess the ability, such as rats and mice, are almost completely nocturnal. Peichl agreed that it's a total mystery why a nocturnal species might need ultraviolet vision.

However, communicating with ultraviolet light reflecting urine does have some drawbacks, said Peichl. One recent study showed that kestrels in Finland improve their hunting success by using the freshness of the urine to distinguish used from abandoned vole trails. "The same may be true for the degu's native predator in Chile," he said.

**SOURCE:**
http://news.nationalgeographic.com/news/2003/07/0708_030708_ultravioletmammals.html