



News B / 2003 (7)

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## An Eye for Scent Marks

### **International research team discovers potential link between ultraviolet vision and urine scent marks in rodents**

**Humans and most other mammals cannot see ultraviolet (UV) light, whereas some rodents can. A Chilean-German research team has now reported UV vision in the South-American degu, a distant relative of the guinea pig. In a search for behaviourally relevant UV signals in the habitat of these rodents, the researchers found that fresh degu urine reflects the UV parts of the spectrum most strongly, while dry old urine has only marginal UV reflectance. The socially active degus use urine extensively to scent mark their communal trails and wallowing places. The researchers postulate that such scent marks represent visual as well as olfactory cues for the UV-sensitive degu (Investigative Ophthalmology & Visual Science, vol. 44, pp. 2290-2296, May 2003).**

For humans and most other mammals, the visible spectrum extends from short-wave blue to long-wave red, ultraviolet (UV) is invisible to them. In contrast, many fish, reptiles and birds can see UV and use it in the identification of conspecifics: In some birds, e.g. blue tits, males and females have different UV patterns in their plumage. UV vision is also important for bird foraging: the waxy cover of many berries has a high UV reflectance. UV vision is part of the sensory equipment of many vertebrates and invertebrates (e. g., honeybees), but has been lost in the evolution of mammals. Not completely, however, as some rodents like mice and rats have retained UV vision. The adaptive reasons for this specialization are largely unknown.

A plausible ecological explanation has now been offered by Leo Peichl at the Max Planck Institute for Brain Research in Frankfurt/Main, Francisco Bozinovic at the Pontificia Catholic University Santiago (Chile), and Andrés Chávez and Adrián Palacios at the University of Valparaíso (Chile). They studied the rodent degu (*Octodon degus*) a distant

Max Planck Society  
for the Advancement of  
Science  
Press and Public  
Relations Department

Hofgartenstraße 8  
D-80539 Munich

PO Box 10 10 62  
D-80084 Munich

Phone: +49-89-2108-  
1276  
Fax: +49-89-2108-1207

E-mail: [presse@mpg-gv.mpg.de](mailto:presse@mpg-gv.mpg.de)  
Internet:  
<http://www.mpg.de/>

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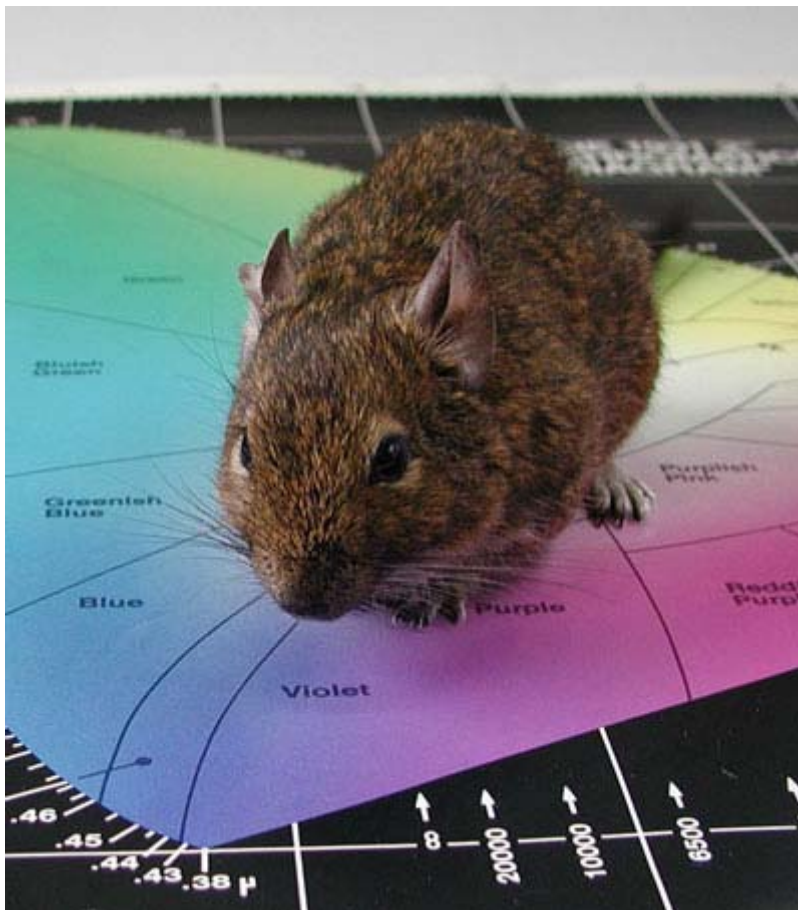
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relative of the guinea pig, which is endemic to Chile and kept as pets worldwide. The strongly diurnal degus inhabit open bushland, where they live in small colonies with a tight social organization. Analysis of degu colour vision by means of electroretinograms revealed that their visible spectrum extended into the near UV. In a search for the advantages that this UV vision might have, the researchers scanned the natural environment of the degus for UV sources. There was minimal UV reflectance off the plants that degus feed on, and off inorganic ground material (soil, sand, stones). But the scientists made a find when they scrutinized the scent marks that the degus use to mark their environment. Among the social behaviour patterns of degus is the use of communal paths when moving around in their territory and the use of common wallowing places. These public trails and places are generously marked with urine and faeces partly for the colonies own orientation, partly as territorial markers against neighbouring colonies.



**Fig.:** This degu (about 10 cm body length) was placed on a colour chart to visualize its spectral range.

*Image: Patricio Velez, Universität Valparaíso*

The measurements showed that fresh degu urine reflects UV much stronger than the longer wavelengths of the spectrum. In contrast, dry old urine mostly reflects longer

wavelengths and very little UV. With their UV-sensitive eyes, degus have the potential to discriminate fresh urine marks from old ones not only by olfaction, but also by vision. Degus can see where a conspecific has recently walked by, and where the current social hot spots are. Olfactory signals are dispersed by air movements and are, hence, rather imprecise markers of location. The visual detection of urine marks should significantly improve localization. This may have been the evolutionary pressure to maintain UV vision.

The hypothesis can be extended to other rodent species. Some species are also known to produce UV-reflecting urine and use it for scent marking (e. g. mice and rats). Previous studies in these species have not addressed the potential link between UV vision and urine UV-reflectance. There is also, however, a drawback associated with the potential advantage of visible scent marks. Diurnal birds of prey also have UV vision, and some years ago Finnish researchers have observed that kestrels discriminate active from abandoned vole trails by UV vision, thus improving their hunting success. It would not be an advantageous evolutionary strategy if rodents could tolerate such a weakness without profiting from the urine UV-reflectance themselves. This further suggests that the visual recognition of scent marks constitutes an advantage which makes up for the increased risk of predation.

#### **Original work:**

Andrés Chávez, Francisco Bozinovic, Leo Peichl & Adrián G. Palacios (2003)

#### **Retinal spectral sensitivity, fur coloration, and urine reflectance in the genus *Octodon* (Rodentia): implications for visual ecology.**

*Investigative Ophthalmology & Visual Science* 44: 2290-2296.

#### **Contact:**

**Dr. Leo Peichl**

**[Max Planck Institute for Brain Research](#), Frankfurt/Main**

**Tel.: (+49) 69 96769-219 (department secretary)**

**Fax.: (+49) 69 96769-206**