All the better to see you with: Snakes alter blood flow dynamics to aid vision

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Much like a pair of closed eyelids a snake's eye is covered layer of skin riddled with tiny blood vessels. Although this layer is transparent Kevin van Doorn for the University of Waterloo, Canada, wondered if the blood vessels caused problems with vision. Delving deeper, van Doorn finds that during periods when clear vision may be advantageous snakes decrease the amount of time the vessels staying dilated, keeping the eye as blood-free as possible.

When Kevin van Doorn found himself setting up an experiment to investigate how snakes' eyes are able to focus at the beginning of his PhD in Jacob Sivak's lab at the University of Waterloo, Canada, he noticed something rather unusual: the bright light beam from the equipment lit up the eye from behind and revealed an array of tiny blood vessels branching their way across the transparent skin covering the snake's eye. This see-through skin, called the spectacle, is found in all snakes and is analogous to our own eyelids, except in the case of the snake, the two halves are fused together and have become transparent. Although snake spectacles are well known, van Doorn recalls: 'I never knew that snakes had blood vessels in their spectacle. In fact, it seems like most vision researchers and even snake researchers, herpetologists, in general had no idea.' So, although van Doorn had initially set out to study how snakes' eyes focus, he decided to turn his attention to these blood vessels instead. He publishes his findings in *The Journal of Experimental Biology*.

First van Doorn wondered who else knew about these blood vessels and

did some investigative work. Delving into the scientific literature, he found one brief report on the eye's vasculature dating back to 1852. With the help of Google Translate, he also found an Italian scientist describing the vessels in 1888, and then with the help of some German-speaking friends, he unearthed Manfred Lüdicke's manuscripts from the 1940s. But by and large, these vessels had fallen under the radar and were a mere curiosity.

Being interested in vision, van Doorn next wondered what implications these blood vessels might have for the snake's eyesight. 'Evolution has done a pretty good job of keeping blood vessels out of the optically transparent portion of the eye, and so from that we can infer that blood vessels in the eye generally have a negative effect on vision', says van Doorn. What's more, Lüdicke had seen that in a snake with foveas (regions of the eye responsible for sharp vision), the overlying spectacle was less densely packed with blood vessels, suggesting that these vessels do affect vision.

To investigate in more detail, van Doorn put his coachwhip snakes into a small thin box made of Perspex glass. Luckily, unlike in most snakes, this small enclosure made the snakes feel safe enough to hunker down and stay still so that van Doorn could use a slit lamp to illuminate and magnify their eyes. van Doorn then hid behind a curtain for half an hour, while a camera attached to the slit lamp recorded the capillaries periodically dilating and contracting to allow and inhibit blood flow, respectively. On average, van Doorn found that periods of contraction lasted for 115 s, before the vessels dilated to allow blood flow to re-oxygenate the eye. Next, van Doorn crept out from his hiding place to perform some routine tasks in the background. However, given their twitchy nature, the coachwhips regarded his presence as a potential threat, and during the 8 min van Doorn spent in the lab, the coachwhips decreased the period of dilation and blood flow down from 57 s to 33.5 s. When van Doorn returned to his hiding spot, the rhythm of contraction

and dilation returned to normal.

Whether the snakes actively reduce blood flow in the eye or do so as a side effect of a sympathetic response induced by a threat, van Doorn doesn't know. However, either way, by reducing the amount of blood in the vessels by prolonging periods of contraction, van Doorn thinks this would allow the snake to see better, which would certainly be advantageous had a real threat been in the room.

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