

Spitting cobras track first, predict later

May 14 2010



Indian Spectacled Cobra. Image credit: Wikipedia.

Most venomous snakes are legendary for their lethal bites, but not all. Some spit defensively. Bruce Young, from the University of Massachusetts Lowell, explains that some cobras defend themselves by spraying debilitating venom into the eyes of an aggressor.

Getting the chance to work with spitting cobras in South Africa, Young took the opportunity to record the venom spray tracks aimed at his eyes. Protected by a sheet of Perspex, Young caught the trails of venom and two things struck him: how accurately the snakes aimed and that each track was unique. This puzzled Young. For a start the cobra's fangs are fixed and they can't change the size of the venom orifice, 'so basic [fluid dynamics](#) would lead you to think that the pattern of the fluid should be fixed,' explains Young. But Young had also noticed that the snakes 'wiggled' their heads just before letting fly. 'The question became how

do we reconcile those two things,' says Young, who publishes his discovery that the snakes initially track their victim's movement and then switch to predicting where the victim is going to be 200ms in the future in the [Journal of Experimental Biology](#) on 14 May 2010.

Young remembers that Guido Westhoff had also noticed the spitting cobra's 'head wiggle', so he and his research assistant, Melissa Boetig, travelled to Horst Bleckmann's lab in the University of Bonn, Germany, to find out how spitting cobras fine-tune their venom spray. The team had to find out how a target provokes a cobra to spit, and Young was the man for that job, 'I just put on the goggles and the cobras start spitting all over,' laughs Young.

Wearing a visor fitted with accelerometers to track his own head movements while Boetig and Westhoff filmed the cobra's movements at 500 frames/s, Young stood in front of the animals and taunted them by weaving his head about. Over a period of 6 weeks, the team filmed over 100 spits before trying to discover why Young was so successful at provoking the snakes.

Analysing Young's movements, only one thing stood out; 200 ms before the snake spat, Young suddenly jerked his head. The team realised that Young's head jerk was the spitting trigger. They reasoned that the snake must be tracking Young's movements right up to the instant that he jerked his head and that it took a further 200 ms for the snake to react and fire off the venom.

But Young was still moving after triggering the snake into spitting and the snake can't steer the stream of venom, so how was the cobra able to successfully hit Young's eyes if it was aiming at a point where the target had been 200 ms previously? Realigning the data to the instant when Young jerked his head, the team compared all of the snakes' head movements and noticed that the cobras were all moving in a similar way.

They accelerated their heads in the same direction that Young's eyes were moving. 'Not only does it speed up but it predicts where I am going to be and then it patterns its [venom](#) in that area,' explains Young.

So spitting cobras defend themselves by initially tracking an aggressor's movements. However, at the instant that an attacker triggers the cobra into spitting, the reptile switches to predicting where the attacker's eyes will be 200 ms in the future and aims there to be sure that it hits its target.

More information: Westhoff, G., Boetig, M., Bleckmann, H. and Young, B. A. (2010). Target tracking during venom 'spitting' by cobras. *J. Exp. Biol.* 213, 1797-1802. jeb.biologists.org

Provided by The Company of Biologists

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