Chameleons' eyes are not so independent

July 8 2015

Oustalet's Chameleon, Ambalavao, Madagascar. Credit: Bernard Gagnon/Wikipedia.

Famed for their ability to change colour, chameleons have yet another mind-boggling talent: their eyes appear to swivel completely independently. This means that they can simultaneously track two completely different views of the world, which is quite impressive from our primate perspective.

However, Hadas Ketter Katz and Gadi Katzir from the University of Haifa, Israel, explain that this phenomenon is more common than we may realise: many fish and birds also have independently wandering eyes, with each eye connecting to the opposite half of the brain - meaning that the left half of the brain should only know what the right eye is seeing and vice versa. However, the duo and their colleagues were less sure that the chameleon's extraordinary eye movements were as independent as they first appeared. Could the left eye know what the right eye is doing when tracking completely different objects? Katzir and his team decided to try foxing chameleons with an illusion to find out and publishes his discovery that the eyes do know where the other is directed, meaning that they do not move completely independently in *The Journal of Experimental Biology*.

Fortunately, the chameleons that Katzir and his team work with are more than happy to play computer games. So, when Ketter Katz and Ehud Rivlin from the Technion, Israel, showed a Minecraft-style insect scuttling across a screen to the chameleons, the enthusiastic gamers focused on it with one eye and precisely estimated the distance to the pixilated treat. Then they locked on to the target with both eyes and stuck out their tongue ready to fire at the screen. 'If you have a very precise behavioural pattern like this, you can tell that both eyes are looking at a target', says Katzir. But then Ketter Katz, working with Avichai Lustig and Tidhar Lev-Ari, played a cunning trick on the chameleons: they split the cyber fly in two. So, having comfortably focused both eyes on the tempting cyber-treat, the chameleon was thrown onto the back foot. Pulling its tongue back, the reptile suddenly had to contend with each eye tracking its simulated fly independently as the images scampered in opposite directions towards the two edges of the screen. How would the chameleons react?

'There are a few seconds of indecision. It knows that it has targets to shoot at but it cannot decide which target is the one to be shot', chuckles

Katzir. However, once the chameleon has made its decision and swivelled the second eye around to focus on the same simulated fly as the first eye, then the chameleon prepares to fire its tongue within a matter of milliseconds. 'If the eyes were independent you would not have expected one to stay put and the other to converge', says Katzir. The fact that the chameleons are able to track objects moving in opposite directions before deciding which object to target and are then able to direct the second eye to where the first eye is gazing suggests that the second eye has some knowledge of where the first eye is directed. They are not independently controlled; there must be cross-talk between the eyes, similar to the cross-talk that gives us binocular vision.

'The capacity of animals to control their sensory systems is greater than we sometimes anticipate', says Katzir, who is now interested in seeing how well the chameleon's eyes coordinate in response to moving threats. 'I think there should be more attention to what animals are actually acquiring as visual information and how they are processing it. Their visual world might be different from ours and we should look into their solutions', says Katzir.

More information: Ketter Katz, H., Lustig, A., Lev-Ari, T., Nov, Y., Rivlin, E. and Katzir, G. (2015). Eye movements in chameleons are not truly independent - evidence from simultaneous monocular tracking of two targets. J. Exp. Biol. 215, 2097-2105. jeb.biologists.org/lookup/doi/10.1242/jeb.113084

Provided by The Company of Biologists