# Rattlesnake rattles trick human ears

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A Western diamondback rattlesnake ready to rattle. Credit: Tobias Kohl

Rattlesnakes increase their rattling rate as potential threats approach, and this abrupt switch to a high-frequency mode makes listeners, including humans, think they're closer than they actually are, researchers report August 19th in the journal *Current Biology*.

"Our data show that the acoustic display of rattlesnakes, which has been interpreted for decades as a simple acoustic warning signal about the presence of the snake, is in fact a far more intricate interspecies communication signal," says senior author Boris Chagnaud at Karl-Franzens-University Graz. "The sudden switch to the high-frequency mode acts as a smart signal fooling the listener about its actual distance to the sound source. The misinterpretation of distance by the listener thereby creates a distance safety margin."

Rattlesnakes vigorously shake their tails to warn other animals of their presence. Past studies have shown that rattling varies in frequency, but little is known about the behavioral relevance of this phenomenon or what message it sends to listeners. A clue to this mystery came during a visit to an animal facility, where Chagnaud noticed that rattling increased in frequency when he approached rattlesnakes but decreased when he walked away.

Based on this simple observation, Chagnaud and his team conducted experiments in which objects appeared to move toward rattlesnakes. One object they used was a human-like torso, and another was a looming black disk that seemed to move closer by increasing in size. As the potential threats approached, the rattling rate increased to approximately 40 Hz and then abruptly switched to an even higher frequency range, between 60 and 100 Hz.
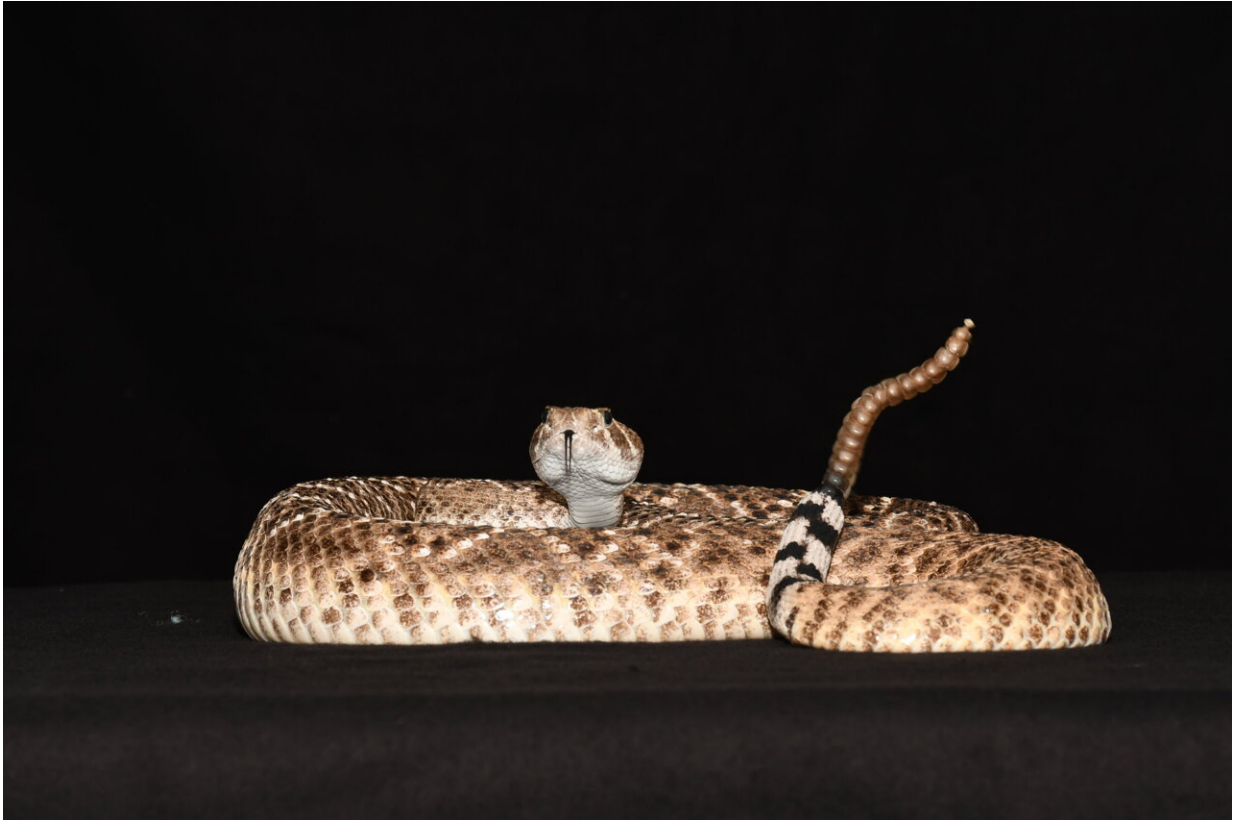
A Western diamondback rattlesnake ready to rattle. Credit: Tobias Kohl

Additional results showed that rattlesnakes adapt their rattling rate in response to the approach velocity of an object rather than its size. "In real life, rattlesnakes make use of additional vibrational and infrared signals to detect approaching mammals, so we would expect the rattling responses to be even more robust," Chagnaud says.

To test how this change in rattling rate is perceived by others, the researchers designed a virtual reality environment in which 11 participants were moved through a grassland toward a hidden snake. Its rattling rate increased as the humans approached and suddenly jumped to 70 Hz at a virtual distance of 4 meters. The listeners were asked to

indicate when the sound source appeared to be 1 meter away. The sudden increase in rattling frequency caused the participants to underestimate their distance to the virtual snake.

"Snakes do not just rattle to advertise their presence, but they evolved an innovative solution: a sonic distance warning device similar to the one included in cars while driving backwards," Chagnaud says. "Evolution is a random process, and what we might interpret from today's perspective as elegant design is in fact the outcome of thousands of trials of snakes encountering large mammals. The snake rattling co-evolved with mammalian auditory perception by trial and error, leaving those snakes that were best able to avoid being stepped on."

More information: *Current Biology*, Forsthofer and Schutte et al.: "Frequency modulation of rattlesnake acoustic display affects acoustic distance perception in humans" www.cell.com/current-biology/f … 0960-9822(21)00973-8 , DOI: 10.1016/j.cub.2021.07.018

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