How cheetahs outpace greyhounds

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Cheetahs are the high-performance sports cars of the animal kingdom, but how do they outstrip other elite athletes when using the same sprint technique? Penny Hudson, Sandra Corr and Alan Wilson from the Royal Veterinary College, UK, compared the performance of captive cheetahs and greyhounds and found that in addition to increasing their stride frequency, the cheetahs spend longer in contact with the ground, probably to protect their limbs from stress fractures at high speed.

In a 0-60 mph stand off, most cars would be hard pressed to give a cheetah a run for its money, and at their highest recorded speed of 29m/s (65mph) cheetahs easily outstrip the fastest greyhounds. But, according to Alan Wilson from the Royal Veterinary College, UK, there is no clear reason for the cheetah's exceptional performance. "Cheetahs and greyhounds are known to use a rotary gallop and physically they are remarkably similar, yet there is this bewitching difference in maximum speed of almost a factor of two," he says. Teaming up with Penny Hudson and Sandra Corr, Wilson decided to compare how cheetahs and greyhounds sprint to see if there were any mechanical differences between the two animals' movements and they publish their findings in The Journal of Experimental Biology.

Knowing that captive big cats are happy to chase a lure, the trio were confident that they could get the cheetahs at ZSL Whipsnade Zoo, UK, and the Ann van Dyk Cheetah Centre, South Africa, to sprint across force plates buried in a track in the animals' enclosure. The problem would be getting the valuable equipment to work in the open. "Force plates are cosseted, loved pieces of equipment that people don't generally

take outside of the lab and bury in the ground in the English summer," Wilson chuckles. However, after successfully installing eight force plates in the cheetahs' enclosure, along with four high speed cameras filming at 1000frames/s, Hudson tempted the cheetahs to gallop along the track with a piece of chicken attached to a truck starter motor while she measured the forces exerted on the animals' limbs, their body motion and footfall patterns. She also repeated the measurements on galloping greyhounds back in the lab, filming the animals at a slower 350 frames/s.

But, when Hudson compared the animals' top speeds, she was surprised to see that the trained greyhounds galloped faster than captive cheetahs, clocking up a top speed of 19m/s compared with the cheetahs' 17.8m/s. Nevertheless, Hudson was able to identify clear differences in the animals' stride patterns that could explain how wild cheetahs would outpace the dogs.

When running at the same speed, the big cats' stride was slightly longer than the greyhounds', although the cheetahs compensated for this with a slightly lower stride frequency. Also, the cheetahs increased their stride frequency as they shifted up through the gears – running at 2.4strides/s at a leisurely 9m/s, rising to 3.2strides/s at their top speed of 17m/s – whereas the greyhounds maintained a constant stride rate around 3.5strides/s across their entire speed range. Wilson suspects that wild cats may be able to reach stride frequencies of 4strides/s, which, in combination with longer stride lengths, may allow them to outstrip their captive cousins and hit top speeds of 29m/s.

Also, when Hudson analysed the length of time that each animal's foot remained in contact with the ground – the stance time – she noticed that for some of the cheetah's limbs it was longer, and the team suspects that this may be another factor that contributes to the wild cheetah's record performance. Explaining that increasing the stance time reduces the peak loads on the animal's legs, Wilson says, "[with] a longer stance time the

cheetah will get to the limiting load at higher speed than the greyhound."

Speculating about the relatively poor performance of the captive cheetahs, Wilson suggests that they may lack motivation. "They have lived in a zoo for several generations and have never had to run to catch food. They have probably never learned to run particularly," he says, adding, 'The next stage is to try to make measurements in wild cheetahs in the hope of seeing higher speeds.'

More information: Hudson, P. E., Corr, S. A. and Wilson, A. M. (2012). High speed galloping in the cheetah (Acinonyx jubatus) and the racing greyhound (Canis familiaris): spatio-temporal and kinetic characteristics. J. Exp. Biol. 215, 2425-2434. jeb.biologists.org/content/215/14/2425.abstract

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