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INSIDE JEB

Humans ditched swivelling hips for shorter stride than chimps

A human volunteer walking on a treadmill while being filmed in 3D. Photo credit: Nathan Thompson.

As a short adult, I marvel at the long strides taken by tall people. Their lengthy legs devour metres relative to my stubby trotting limbs. But compared with the strides of our closest relatives, even the tallest amongst us take relatively short steps; 'standardized by size, humans really don't have long strides', says Nathan Thompson from the New York Institute of Technology, USA. However, until recently, most scientists believed that the human stride was relatively long for efficiency; 'this is taught in almost every introductory class and textbook', Thompson says, although the misconception only became truly apparent when he began delving into the literature. And when Thompson began investigating how far chimpanzees rotate their pelvises as they walk, he began wondering whether swivelling their hips could hold the key to the chimpanzee's longer strides. Intrigued by the possibility, he decided to compare chimps and humans walking over a range of different speeds to find out whether the pelvis rotation provides the chimp's longer stride.

'Working with people and animals always has its difficulties', says Thompson, who spent several years with Brigitte Demes, Susan Larson (both at Stony Brook University, USA) and Matt O'Neill (Midwestern University, USA) familiarising the chimpanzees with walking upright on two feet while they filmed the animals in 3D. Even working with the human walkers wasn't without its challenges. Thompson remembers one volunteer who kept getting fits of the giggles because walking in bare feet on the treadmill felt weird; 'they couldn't help but walk in a totally bizarre way', Thompson recalls.

Once Danielle Rubinstein, William Parrella-O'Donnell and Matt Brett reconstructed the human's stride pattern and hip motions in 3-D, the team scaled the humans down to the size of the chimpanzees and found that although the humans' legs were proportionally 112% longer, their strides were 26.7% shorter. Meanwhile, the chimpanzees swivelled their hips between 28 and 61 deg in contrast to the humans, which barely twisted their pelvises at all, by only ~8 deg. And when the team checked how much further the pelvic rotation got them in terms of stride length, the chimpanzees had a distinct advantage. Their swivelling hips extended their stride 5.4 times more, relative to their size, than the human's diminutive swivel.

'I think that chimpanzees use pelvic rotations to try to squeeze every bit of stride length out, otherwise their strides would be – absolutely – very small', says Thompson, explaining that apes and monkeys tend to walk on crouched legs that naturally shorten their stride; 'I don't think there are a lot of options other than rotating the pelvis, given their anatomical constraints', he adds.

But why have humans ditched swivelling their hips when it could extend their strides further? Thompson suggests that extreme rotations of the hips could throw out the natural swing of our arms and legs – which counterbalance each other – forcing our muscles to work harder and making walking less efficient; a price that simply might not be worth paying for an increased stride length. Thompson also explains that scientists had thought for decades that humans had evolved the longest possible stride for efficiency, but now that it turns out that our stride is considerably shorter than that of our nearest cousins, he suspects that other factors have had a larger impact on the way we walk. 'Humans have had about 7 million years of selective pressure for economical bipedalism; this means that there has been a lot of time to experiment with the costs and benefits, so it might be worth it to walk with slightly shorter strides, because whatever energy we lose, we might make up elsewhere', he suggests.

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Thompson, N. E., Rubinstein, D., Parrella-O'Donnell, W., Brett, M. A., Demes, B., Larson, S. G. and O'Neill, M. C. (2021). The loss of the 'pelvic step' in human evolution. *J. Exp. Biol.* **224**, jeb240440.

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