Riders take load off horses

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Horses experience back pain so riders do their best to minimise the loads exerted on horses' backs, but how much of a difference do the different trotting techniques make to the loads horses experience? Patricia de Cocq from Wageningen University analysed riders on trotting horses and discovered that 'rising trot' reduces the load significantly. She also built a computational simulation of a horse and rider that explains why jockeys ride so fast.

Patricia de Cocq is a keen horsewoman, but her interest in horses extends beyond her passion for riding: she is also a vet. Interested in the animals' welfare, de Cocq explains that many horses that are ridden experience back pain that is hard to treat. Which made her wonder: could riders modify their technique to reduce the load exerted on their horses' backs? Analysing the movements of riders on trotting horses, de Cocq discovered that 'rising trot' significantly reduces the load exerted on horses' backs. She also built a computational simulation of a horse and rider that could help riders discover better ways of riding and publishes her discovery that jockeys ride fast because their centre of mass barely moves at all in *The Journal of Experimental Biology*.

According to de Cocq, from Wageningen University, The Netherlands, riders have a choice of two techniques when perched on a trotting horse: the easier 'rising trot' – when the rider bobs up and down, standing in the stirrups when off the saddle – and the more technically challenging 'sitting trot', where the rider remains firmly seated. As rising trot was thought to reduce the load exerted on a trotting horse's back, de Cocq travelled to Hilary Clayton's lab at Michigan State University, USA, to

use Clayton's state-of-the-art 3D motion capture equipment to test the theory. By filming experienced dressage riders as they trotted using both techniques and analysing the motion of each horse and rider, de Cocq could see that the centre of mass of riders using rising trot moved much less during the standing phase than the centre of mass of sitting trot riders, reducing the force exerted on the horse's back and lessening the chance of injury.

However, while de Cocq was analysing the data, she came across a paper in Science (Pfau et al., Science, 325, 289) that explained how the technique used by modern jockeys – where they stand in their stirrups – had significantly improved times in horse racing. de Cocq noticed that jockeys' posture was similar to the standing phase of the rising trot. She wondered whether she could build a mathematical model of a horse and rider that would simulate the movement of a rider's centre of mass and identify factors that could reduce the force exerted by the rider on a horse's back.

Teaming up with Mees Muller and Johan van Leeuwen, de Cocq built three increasingly sophisticated models, representing the horse and rider as systems of springs, dampers and point masses. Then, by varying the stiffness of the spring representing the rider in the simplest model, de Cocq successfully reproduced the motion of the rider's centre of mass during sitting trot and when using the jockey's standing posture. Then, when she repeated the calculations using the second model where she added a damper and brief free-fall to the first model, the motion of the centre of mass of the sitting trot rider and the jockey was even more lifelike. But neither model reproduced the motion of a rider's centre of mass during rising trot until de Cocq and van Leeuwen added a second spring – mimicking the rider's leg during the standing portion of the stride – to the simulated rider spring. By alternating between the two springs – activating the leg spring during the standing portion of the stride and the rider spring during the seated portion – de Cocq

successfully simulated the rising trot.

de Cocq's calculations also showed how difficult the jockey's technique is. She could only simulate the relatively smooth motion of the jockey's centre of mass using a narrow range of spring stiffnesses and damping; and only one combination of spring stiffness and damping produced the optimal situation where the jockey's centre of mass followed an almost flat line. de Cocq points out that the current technique used by jockeys allows horses to gallop faster than other techniques. However, it requires a huge amount of strength and training and she says, 'If jockeys want to improve even more they would need to go in a straight line, not move up and down, and that would be a challenge.'

More information: de Cocq, P., Muller, M., Clayton, H. M. and van Leeuwen, J. L. (2013). Modelling biomechanical requirements of a rider for different horse-riding techniques at trot. J. Exp. Biol. 216, 1850-1861. jeb.biologists.org/content/216/10/1850.abstract

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