



## Science-in-brief: Horse, rider, saddlery interactions: Welfare and performance



On 8-10 December 2018 the Saddle Research Trust hosted their 3rd International Conference and workshop. The theme was *Horse, rider, saddlery interactions: Welfare and performance*. This article summarises the presentations and discussions that took place.

### Conference report

The conference was sponsored by World Horse Welfare and Wow™ Saddles and chaired by Professor René Van Weeren from Utrecht University. The day began with a talk on rider asymmetry by Russell McKechnie-Guire of Centaur Biomechanics. When viewed from the front or rear, riders often show left-right asymmetries in position and/or movements which may be a primary rider fault or secondary to saddle slippage. When the saddle displaces, the rider's seat rotates with it but the trunk rotates in the opposite direction. If the saddle rolls to the right, pressures are higher beneath the left side and this is associated with greater stance-phase extension of the horse's left fore fetlock, which indicates greater limb loading. Centring the saddle results in a more uniform pressure distribution and improves kinematic symmetry of both horse and rider [1]. The direction of saddle slip can be predicted by having the unmounted horse stand squarely while the neck is moved to the left and right sides. The saddle slips when the horse bends one way and remains straight when bending the other way. This suggests that saddle asymmetry can be induced by the horse with the rider following the saddle.

Riders apparently have poor perception of their weight distribution. When sitting on a horizontal surface, average values for a group of riders indicated they had more weight on their left seat bone. Asymmetrical weight distribution is transmitted to the horse: if stirrup length differs, horse loading is increased in the fore and hindlimbs on the side with the longer stirrup length and lateral range of motion (ROM) increases in the thoracolumbar region.

The saddle's tree width affects both horse and rider kinematics. Pressure increases in the cranial thoracic region under a wide saddle and in the caudal thoracic region under a narrow saddle. The rider's pelvis tilts anteriorly in the wide saddle, which hollows the rider's back, and tilts posteriorly in the narrow saddle, which rounds the rider's back. Therefore, riding in a wide saddle is potentially a cause of excessive thoracic lordosis in the rider.

Dr Thilo Pfau from the Royal Veterinary College discussed recent advances in the applications of inertial sensors for measuring asymmetry in horses in the context of lameness diagnostics [2]. Measuring thoracolumbar movement before and after abolition of lameness demonstrates increased thoracolumbar ROM. This reinforces the idea that 'back stiffness' perceived by a rider does not necessarily reflect primary thoracolumbar pain but may be an adaptation to lameness [3]. Differences in contralateral hindlimb length are associated with small pelvic movement asymmetries, highlighting the importance of considering sources other than pain in horses presenting with very mild gait abnormalities.

Professor Lars Roepstorff from the Swedish University of Agricultural Sciences described the results of Maria Terese Engell's doctoral research which evaluated frontal plane symmetry patterns of the pelvis, trunk, and head of riders who had one foot that was more pronated than the other. When walking, there is a pronounced pelvic drop in many riders during weight-bearing on the foot contralateral to the more pronated one [4]. When rocking a balance chair from side-to-side, riders do not show a symmetrical left-right pattern of frontal plane rotation and translation. Inter-segmental strategies vary greatly. Pelvic/trunk roll when rocking the chair is asymmetric and larger to the side of the more everted foot [5]. Riders adopt the same postural asymmetries when riding as when rocking the chair. The rider's pelvis is particularly important for communication with the horse and it is generally believed

that a symmetrical rider is more likely to influence the horse in an optimal way.

In her keynote talk, Professor Emerita Hilary Clayton from Sport Horse Science in the USA addressed the sources of locomotor asymmetry in horses, focusing on causes not related to lameness. She described how rhythmic limb movements are produced by central pattern generators (CPGs) in the cervical (forelimb) and lumbar (hindlimb) regions of the spinal cord. The CPGs generate rhythmic joint flexions and extensions that drive limb protraction-retraction and raise and lower the hooves. Slight differences in magnitude or timing of the outputs of the left and right CPGs can cause functional asymmetries that are non-pathological and non-responsive to nerve blocking. Motion asymmetries arising in the CPGs affect the left and right sides randomly and do not have a systematic pattern. By contrast, sidedness originating in the motor cortex gives rise to a consistent left-right pattern of asymmetries. Horses are known to exhibit preferences in use of the eyes, ears, and limbs. Systematic asymmetries in the locomotor system include:

- asymmetrical feet (high-low syndrome) associated with kinematic and kinetic asymmetries [6]
- symmetrically handled foals and 2-year-olds are more likely to leave the rail and cut across the circle on the right rein compared with the left rein [7]
- asymmetrical torques around the fore feet in the horizontal plane at walk (internal in the left fore, external in the right fore) [8]
- during walking the withers may drop asymmetrically during weight transfer between the forelimbs and this is associated with a directionally consistent pattern of contralateral differences in limb protraction and retraction distances and lateral deviation of the haunches [9].

Taken together the findings of different studies are starting to indicate a kinematic sidedness pattern resembling descriptions in the equestrian literature of the typical crookedness patterns that are addressed during training with the goal of 'straightening' the horse.

In the second keynote talk, Dr Sue Dyson from the Animal Health Trust and SRT Honorary Veterinary Advisor addressed the topical area of pain recognition in relation to lameness evaluation of ridden horses. She described her studies of facial expressions and other behaviours that may be associated with pain in ridden horses.

By comparing non-lame and lame ridden horses, an ethogram was developed which describes 24 features of behaviour, many of which must be displayed for a prescribed length of time to qualify for inclusion [10]. In lame horses ridden before and after lameness was abolished by diagnostic analgesia, reduction in behaviour scores verified the causal relationship between pain and behaviour [11,12]. Appropriate training is required for accurate interpretation of the ethogram; however, the ethogram offers a potentially valuable tool for owners, trainers, veterinarians, saddle fitters and other paraprofessionals to identify the likely presence of musculoskeletal pain, even in the absence of obvious lameness. Horses are trying to communicate; we have to learn to understand them, rather than dismissing their signals as 'naughty horse behaviour'.

The first half of the afternoon programme was devoted to a description of a recently completed rider weight pilot study, delivered by Pat Harris, Sue Dyson, Laura Quiney and Anne Bondi. Objective gait analysis demonstrated a positive correlation between rider weight and equine pelvic movement asymmetry and behavioural markers correlated to rider weight. There were no differences in equine salivary cortisol concentrations between riders. These researchers did not suggest that heavy riders should not ride, but advised that if they do, they should select a horse of appropriate size and fitness, with a saddle that is correctly fitted for both horse and rider [13].

The final part of the day was a series of short presentations entitled “*The equine industry, research and the future*”. Dr David Marlin addressed the challenges to equine welfare and performance. Eleanor Jones covered the welfare issues that have received media focus. Jenny Hall discussed the question of how the sport’s governing bodies will face the future challenges. Sue Norton talked about the steps being taken within the saddlery industry to address the need for change. Roly Owers discussed the concept of social licence. Finally, Olympic equestrian Richard Davison gave his personal reflections on the information that had been presented throughout the day. A lively panel discussion closed the day.

The student award for best poster went to Rhiannon Price (University of Nottingham) for her study, performed in association with the Animal Health Trust, ‘Can horse-owners be trained to evaluate the facial expressions in photographs of ridden horses?’ After undergoing on-line training, horse owners achieved scores that were comparable with those of an expert equine clinician. The open award went to Selma Latif (University of Zurich) for the study ‘The importance of the twist in the context of proper saddle fit’. This demonstrated that saddles with a narrow twist were associated with higher focal pressures and hypertrophy of spinalis thoracis muscle, compared with better fitting saddles.

## Workshop report

The conference was followed by a 2-day workshop sponsored by Albion England, chaired by Prof René van Weeren, facilitated by Prof Pat Harris and attended by invited representatives from industry and research.

Brigadier Philip Napier, Clerk to the Worshipful Company of Saddlers, reviewed the progress of the Saddle Fitting (Training and Qualification) Steering Group (SMSG) while Sue Norton, a saddle fitter with the family-run business Saddle Doctors in Oxfordshire, discussed the challenges faced by the saddlery fitting profession. David Kempself, MD of First Thought Equine, emphasised the need for innovation in saddle design. Reliance on tradition and reluctance on the part of riders, trainers and retailers to embrace innovation and change were presented as challenges that need to be overcome in order to make real progress in saddle manufacturing. As a condition for acceptance of change, customer education is paramount.

Bioengineer Dr Pauline Martin spoke about horse-saddle interactions during exercise. She highlighted the challenges facing saddle designers in producing a functional interface between two biomechanical systems: horse and rider, while Master Saddler Laurence Pearman talked about the challenges facing the experts who train the next generation of saddle fitters. The Society of Master Saddlers offers a mentorship programme to address this issue. Dr Anne Bondi identified the need for better collaboration and communication between the scientific community and the equine industry as a prerequisite to meaningful progress in equine research. Dr Anna Walker compared the experience of riding a real horse vs. a simulator. Riders are frequently injured, with up to 81% of rider falls requiring medical attention [14]. Horse simulators are a cost-effective method for riders, especially novices, to practice their skills with little risk of injury. Anecdotal evidence indicates differences between movements of a horse and a simulator and the effects on rider stress [15], kinematics and kinetics [16,17] that limit the value of the current generation of simulators.

Simulators are most popular for racing, though dressage and jumping models are available. Professor Heikki Handroos from Lappeenranta University of Technology in Finland presented details of the technical challenges he faced in the development of his novel horseback riding simulator and discussed the key technical solutions to these issues. It should soon be possible to develop a fully programmable riding simulator providing a highly realistic riding experience both in dressage and jumping.

Professor Agneta Egenvall from the Swedish University of Agricultural Sciences talked about assessing the interactions between horse, saddle and rider with special reference to the application of epidemiological concepts. Even with sophisticated measuring equipment, subjective evaluation is still necessary and she encouraged researchers to make available video archives of their studies. Dr Anne Bondi discussed the assessment of the rider and the rider’s effect on the interaction with the horse while Dr Thilo Pfau addressed the recent animated debate amongst researcher and practising veterinarians about defining lameness in the context of the increasing use of gait analysis in clinical practice [18–22].

Professor Hilary Clayton talked about what scientific evidence is needed to inform industry best practice. Drawing on the materials presented in the meeting, she reviewed what information is needed and the appropriate outcome variables. There are clearly concerns about the mechanical effects of rider weight on the horse, although it is not known whether the rider’s weight has a linear effect or if there is a threshold value beyond which the effects of rider weight become manifest. The confounding effects of different rider morphologies and skill levels also need investigation.

Each day of the workshop included small group break out discussions which highlighted the need to: 1) Proactively communicate scientific information about saddlery to the equine industry. The SRT was tasked with exploring this topic, 2) Perform research and deliver educational programmes emphasising how rider ability and fitness affect equine welfare and performance, 3) Understand the effects of lameness, primary back pain and the rider on the horse’s thoracolumbosacral region, 4) Disseminate information regarding the limitations of current technologies and encourage the development of improved technologies to measure key variables including pressure mapping and rein tension, 5) Develop standardised protocols for investigations such as lameness evaluation of the ridden horse.

Olympic dressage rider Richard Davison outlined a duty to improve the overall standard of care by educating every retailer, every trainer and every equine professional. He challenged the audience to consider how to effect the necessary changes and galvanise true innovation based on hard facts and rigorous R & D by taking responsibility for educating the equestrian world.

## Conclusions

Over the course of 3 days, participants in the SRT conference and workshop were informed about recent and on-going studies of the rider-saddle-horse interaction, priorities for future investigations were established and new research collaborations were formed. The next SRT Conference and Workshop is scheduled for 11–13 December 2021.

The Saddle Research Trust is a UK-based charitable organisation that acts as a link between research, education and industry. It supports research on the horse-saddle-rider interaction. Further information is available at [www.saddleresearchtrust.com](http://www.saddleresearchtrust.com).

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No competing interests are declared.

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## Authorship

All authors have made a substantial contribution to drafting the article and have approved the final version.

**H. M. Clayton<sup>†</sup> , S. Dyson<sup>‡</sup> , P. Harris<sup>§</sup>, R. van Weeren<sup>#</sup> and A. Bondi<sup>¶</sup>**

<sup>†</sup>Sport Horse Science, LC, Mason, Michigan, USA; <sup>‡</sup>Centre for Equine Studies, Animal Health Trust, Kentford, Newmarket, Suffolk, UK;

<sup>§</sup>WALTHAM Centre for Pet Nutrition, Waltham-on-the-Wolds, Melton Mowbray, Leicestershire, UK; <sup>#</sup>Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, Utrecht, the Netherlands

and <sup>¶</sup>Saddle Research Trust, the Old Barns Worksop, Derbyshire, UK

E-mail: [claytonh@cvm.msu.edu](mailto:claytonh@cvm.msu.edu)

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